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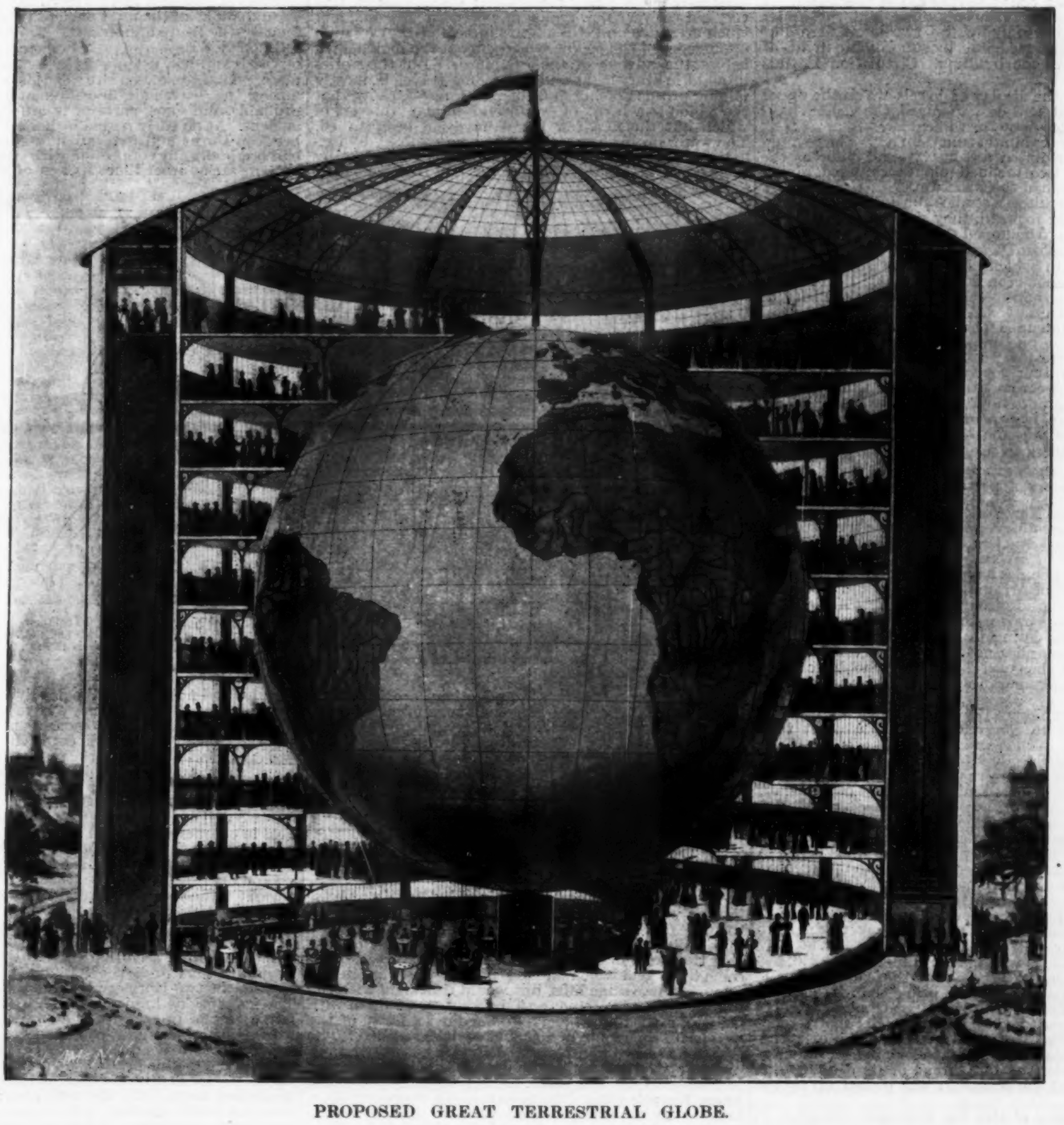
PROPOSED GREAT TERRESTRIAL GLOBE.

MR. T. RUDDIMAN JOHNSTON, F.R.G.S., F.R.S.G.S., has made plans for the erection in London of a great terrestrial globe on a scale of one five hundred thousandths actual size; i. e., a globe having a diameter of 84 feet and showing the earth's surface on a scale of about eight miles to the inch. This scheme is more ambitious than that which resulted in the erection of a globe of half this diameter at the Paris Exposition of 1889. On the proposed globe every geographical feature of importance would be shown and named, as would also be every city or town having 5,000 inhabitants, or even less. The larger cities could be drawn to scale, and various styles of lettering could be adopted.



PROPOSED GREAT TERRESTRIAL GLOBE.

The surface of the globe would contain 22,000 square feet, and would, if developed into a band one foot high, measure over four miles in length; but unless the globe can be made in a reasonable time it will be difficult to secure interest in it. Mr. Johnston has, however, developed plans by which it can be constructed in less than two years, and which would make subsequent correction easy.

The globe would open for observation from a spiral gallery running round it, to the upper end of which the spectator would be taken by an elevator, and, as the globe is slowly revolved, every portion of its surface will come into view.

As various colors can be employed, great clearness can be obtained by showing rivers and lakes in blue, mountains in their natural color, etc. The colors used on the physical features could be made to suggest the frigid zone at the poles and could be given a warmer tone as the tropics are approached.

The extent to which physical geography could be indicated on the globe will be decided after those interested in this branch of science have expressed their views. On the oceans there is ample room to show currents, prevailing winds, temperature, salinity of the sea, the depth and nature of ocean beds, pressure of the atmosphere and variation of the compass; but on the land, though the geographical distribution of plants and animals and even other matter may indicated, it should not be forgotten that the globe is not intended to supersede atlases and reference books, but to encourage their use, and that the general public will visit it more for general information than for scientific research. Anything that will excite the public interest in geographical matters should be inserted on the globe, but it should not be crowded, as so many atlases are, with information that can be better supplied in another form, as this is more likely to repel than attract those desirous of gaining information from it.

This globe, unlike a map, would not distort, but would show all countries in their relative positions, and of their correct dimensions, and the land will be so tinted and the mountains so shaded that a graphic representation of the earth's surface conditions will be given.

Mr. Johnston has had six sections of the globe prepared. These sections, which include Egypt, England, France, etc., are at present on exhibition at Mr. Johnston's establishment, in London. Such a map would certainly tend to create an interest in England in the enormous extent of the colonies of the empire.

THE NEW MUSEUM OF EGYPTIAN ANTIQUITIES AT CAIRO.

A SHORT time since it was announced that the Egyptian government had intrusted the design of the new Museum of Antiquities to M. Dourgnon, one of the four architects recommended by the technical committee into whose hands the examination of the competitive designs had been placed.

M. Dourgnon has now modified his scheme, working it out at Cairo, so as to accommodate the building to the necessities of the case. An examination of his revised drawings shows that in general principle he retains the original idea which recommended his scheme to the judges. On either side of the principal facade, and detached from it, are the houses of the officials. At the right and left extremities of the façade are the library and the salesrooms respectively, the latter being approached only from the outside.

The design of the façade has been simplified and improved. With a lofty archway in the center, it indicates the arrangement of the plan within, which is characterized by great directness and simplicity. There is a great hall running parallel with the façade, and with stairs at either end; while at right angles with it, and leading directly away from the entrance, which lies within the lofty archway, is another great hall. These two form, as it were, a letter ⊥, the angles of the ⊥ being filled with courts and rooms, reducing the whole

structure to a more or less rectangular plan, so arranged that on the right and left sides additional rooms can be added.

One of the conditions imposed upon the competitors was that even the ground floor of the museum should be raised upon arches—a condition essential to maintain the dryness of the building and of its contents. This is, of course, a source of considerable expense; but it adds not a little to the dignity of the structure, and the architect proposes to take advantage of the arrangement, and place part of the floor of his large gallery, that which forms the leg of the ⊥, and leads away from the entrance, at the level of a few steps below the general floor of the building. In this gallery most of the largest objects for exhibition will be placed, and we know with what good effect the floor has been sunk, and how additional points of view are gained thereby, in the Mausoleum Room at the British Museum.

To describe the plan more in detail: Entering the building at the central point of the façade, the visitor will find himself in a long gallery running to the right and left, while in front of him he will look forward into the great gallery forming the leg of the ⊥. The architect has designed the gallery parallel with the façade, with openings in the ceiling so large that the apartment may be considered as one running through from floor to roof of the building. The visitor, turning to the left or to the right, will see a large staircase facing him at the end of the gallery, under the half spaces of which are arranged the water closets and lavatories. Directly over his head, on entering, and at the point of junction of the two galleries, he will see a circular opening in the ceiling, throwing into one the upper and lower floors, and far overhead a low dome. The side exhibition rooms of the museum are all of one story in height, and are alternately ceiled and lighted from the top; the rooms that are ceiled having rooms over them. A very large upper floor is thus obtained, and this upper floor is reached not only by the two large flights of stairs already mentioned, but by subordinate flights at the extreme end of the building. Circulation is thus made easy.

The rooms for the display of jewels are on the upper floor, well isolated and easy to guard, the visitors having to enter and leave by the same door.

Heavy objects—and in this museum a very large number of objects exhibited are heavy—will enter at the rear, there being two inclined planes arranged, giving access to either side of the structure.

As far as the architect's studies for finishing the interior are yet carried forward, they show great simplicity of detail, and it is to be hoped that this will be retained. A museum to contain Egyptian antiquities is one, before all others, in which the greatest simplicity and dignity of treatment is most important. For the exterior it is to be hoped that the same simplicity of treatment will be observed.

It had been intended that the foundations of the new building should be prepared next winter; unfortunately, the advance toward the south has made it expedient for the Egyptian government to hold its hand for a time. The works are not to be begun this year, but there is every reason to hope that they will not be delayed more than a few months, as it is most distinctly intended that the museum shall be built at the first opportunity.—American Architect.

ARCHÆOLOGICAL REMAINS IN ARIZONA.

A WRITER in the New York Sun has brought together the following interesting reports regarding the discovery of relics of the cave dwellers and cliff dwellers in Arizona. Dwellings of several kinds and other relics of these prehistoric peoples have been found all over the northeastern part of Arizona, in Apache and Coconino Counties and in the adjoining parts of New Mexico, and now and then some prospector or other chance traveler who has been wandering in that region comes across highly interesting relics not previously known. The whole region is believed by those who have traveled in it to offer a remarkably rich field for archæological research.

Two amateur explorers, George Campbell and Everett Howell, returned to Flagstaff, Arizona, a short time since from a tour in the region northeast of that town, and reported some highly interesting finds of well preserved cliff dwellings. In the immediate neighborhood of Turkey Tanks, eighteen miles northeast of Flagstaff, they found the finest collection of dwellings yet discovered in that region. The dwellings were built in the walls of a narrow and rocky cañon. Six dwellings in one group were practically intact, the walls being in an almost perfect state of preservation, and presented in every way a much more habitable appearance than do other cliff dwellings in Arizona with which the two explorers were familiar. Several unusual features of the dwellings seemed to indicate that they might have been occupied by chiefs or the family of a ruler.

Near the dwellings was a large tunnel of natural formation running far into the side of the cañon. In the tunnel were remains of walls showing that it at some time had been divided into roomy apartments. There appeared to be scattered about the tunnel many relics of the people who had lived in it, but the explorers were not provided with lights adequate for any extended exploration of the tunnel or its contents. A bone ring of good workmanship was picked up on the floor.

Along the valley of the Rio Colorado Chiquito, in Apache County, there are many ruins of the habitations of cliff dwellers, and also of Aztecs and Toltecs, who lived in walled towns. Near St. John's, the county seat of Apache County, there are extensive ruins of two considerable towns that apparently at one time contained a population of several thousand each.

A writer in the Holbrook Argus tells of several explorations in that region which yielded highly important results. Near one extensive group of ruins some twelve miles south of St. John's he found several years ago a storehouse of Indian antiquities. On the summit of a rocky eminence rising from the river bank opposite one of the ruined towns he found a fissure extending sixty or more feet into the hillside. The entrance was narrow, but the interior was quite large. Heaped on the floor of this cave were hundreds, perhaps thousands, of bows and arrows. Many of the bows were decorated with lizards and snakes painted in bright colors that seemed to have kept all of their original freshness. There were also stone axes and hammers, baskets and a variety of ornaments of shell and stone. The discovery of these relics was made on a chance visit, and the explorer was not provided with facilities for extended investigation. He had one or two candles, and he examined the cave while these lasted. The articles in the cave seemed to have been thrown in there in confusion, as if in great haste and excitement. When the writer was able some time later to visit the cave again, he found that either Indians or Mexicans—and, judging from the traces left, he thinks probably Mexicans—had sheltered in the cave and set fire to the whole mass of arrows, bows, baskets and other relics. The antiquities had been destroyed either purposely, in ignorance of their value, or accidentally had caught fire from a camp fire kindled in the cave. There were enough noninflammable relics remaining, however, to form an interesting collection.

A recent visit to the neighborhood of the cave shows that the little hill in which it is situated was at one time a fortified stronghold. Near the summit are remains of a wall which apparently encircled the extreme summit, inclosing a space some twenty-five feet in diameter. In the middle of this space was a perfect globe, twelve inches in diameter, cut out of basalt. Twenty yards above the base of the hill are the remains of another wall, which also appears to have encircled the hill originally. The ground all round the base of the hill is covered with small broken stones, and there are many indications that these stones were thrown from some primitive weapons, probably slings, in defense of the fortified hill.

Further south from this place and still near the river the Argus writer found other ruins of practically the same characteristics. And all over that part of Arizona there are known to exist ruins of the same class. Expert archæologists from American and European colleges have made many remarkable discoveries in this very old yet very new region of northern Arizona, and much is known and still more is indicated of the high intelligence of the people who occupied the region long before the advent of the Spaniards. But the stories brought in every little while by chance travelers, mostly mining prospectors, of finds of rare interest, show that the region is a book of wonderful human interest of which but the first few pages have yet been turned. The water problem, which is now being solved by irrigation works, was solved ages ago in the same way by this people, and many of the canals and reservoirs they built are in process of repair, and others are in use as they were centuries ago. Becker Lake, an immense reservoir near Springerville, not many miles from St. John's, was built by an ancient people, and is used for irrigation purposes by the people living thereabout today, and the canal by which it is filled from the Little Colorado River is the one built by the ancients and is in practically the same condition to-day as when they built it.

SUN SYMBOLS IN ANCIENT EGYPT.

By F. W. Read, in Knowledge.

AMONG all the objects worshiped by the Egyptians, the sun was the most honored. It was he who furnished the type of the immortality of the human soul; as he sank daily behind the Libyan Hills and rose again daily over the Arabian Desert, so man, his creature, did not come to an end when he too passed westward to his grave in those same hills, but would rise again with the sun, his lord. To come forth by day, to triumph with the sun, is the object, again and again set forth, of the wonderful collection of religious writings called "The Book of the Dead." But the daily journey of the sun also gave rise to another kind of symbolism. Passing in triumph over the earth, he is its king; and to the pious Egyptian the Pharaoh was his representative, bearing all his titles, clothed with all his attributes, wielding all his powers. One of the titles of the Pharaoh was "Son of the Sun;" another was "Horus," and Horus was before all things a sun god. On the beautiful statue of Khafra, the pyramid builder (about B. C. 3700), one of the oldest works of Egyptian art, the Hawk of Horus, stands behind the king's head, spreading its protecting wings.

Although, in common with the moderns, the Egyptians sang the golden glories of the sun, the one thing that impressed them above all others was the fact that, wherever he went, he divided that over and through which he passed into two parts—the north and the south. When viewed in this light, heaven is "the two heavens," earth is "the two earths," and the space beneath the earth is "the double divine under-world," or "the double hall of Maat." The explanation of these phrases is to be found only in the fact of the sun's daily passage over all countries. As he passes over them he divides each into two, and therefore every country and every nome could be spoken of as "the two earths." Of course, Egypt among the rest might be described in this way, and it is possible that the expression sometimes has a double significance; but there is evidence that, down to the time of the Ptolemies at any rate, the distinction between "the two Egypts" and "the two earths" was well recognized by the learned class.

The pyramid texts, of which the first was discovered in 1880, and only recently published by Maspero, throw much light on this question, as they do upon nearly the whole of Egyptian mythology. In the pyramid built for King Teta (about B. C. 3300) we read: "Teta comes to the two heavens, Teta arrives at the two earths; Teta treads upon the herbage growing under the feet of Seb, he traverses the roads of Nut." The first part of this passage ought of itself to be sufficient to settle the meaning of the phrase "the two earths," since it occurs in connection with "the two heavens," and, obviously, "the two heavens of Egypt" would be absurd. But the second part takes us farther still; from it we see that the two heavens are equivalent to the goddess Nut (the sky), and the two earths to the god Seb (the earth).

This doctrine of duality, which has been briefly indicated, found expression in many ways, but chiefly in the titles of the king. The word "king" itself is expressed in Egyptian by seten nat, which, fully translated, means "king of the south and king of the north." Another common title, parallel with seten nat, is "lord of the two earths." The parallelism, indeed, is curiously exact, for, just as one could use "two earths" and "earth" interchangeably, so one could express the idea of king by either seten or nat—preferably the former, which from various causes acquired a pre-eminence.

A consideration of the other symbols of the same doctrine will take us a little deeper into the regions of mythology. Those who only know Horus and Set from the writings of Plutarch and his copyists will be surprised to learn that one of the most ancient titles of the Egyptian king is "the Horus and the Set." According to Plutarch, Typhon (Set) slays his brother Osiris, and Horus, the son of Osiris and Isis, defeats Set and reigns in his father's place. That some such story as this was told in Egypt during the Ptolemaic and Roman periods is highly probable, and some parts of it are demonstrably very ancient. At an early period we hear of a desperate fight between Horus and Set, but it does not seem to have had originally any connection with Osiris; and the combatants are at other times spoken of as friends and colleagues, and not at all as the deadly enemies described by Plutarch. The king, as we have said, is called "the Horus and the Set," and sometimes the "Golden Horus and the Golden Set;" he is depicted standing between two gods, who sometimes purify him with water, sometimes pour the symbols of life and power over him, sometimes instruct him in the use of arms. The two gods are spoken of as brothers having sovereignty over the two divisions of the earth; and that they are identical in character is proved by the use of the expression "the two Horus gods" as the equivalent of Horus and Set. The famous queen Hatshepsu (about B. C. 1600) says on her great obelisk at Karnak: "I bear the white crown (of the south), I am diademed with the red crown (of the north); the two Horus gods have united for me their divisions; I rule this earth like the son of Isis (i. e., Horus), I am victorious like the son of Nut (i. e., Set)." It will be seen that there are here three phrases in parallelism: first, the white and the red crowns; second, the two Horus gods; and, third, Horus and Set. The inscriptions known as "The Book of Hades," relating to the progress of the sun through the underworld during the night, contain two representations of a god with two heads, those of Horus and Set, who is called "the double-headed." In one case he stands on two bows (evidently another of the many symbols of north and south), and the text says: "The two bows bear the double-headed in his mystery; they direct Ra to the eastern horizon of heaven, and they advance on high with him." Here we find Horus and Set not only conjoined in one person but actually identified with Ra (the sun god), proceeding toward the eastern horizon of heaven and advancing on high. These and other texts point to the true interpretation of our pair of gods: they symbolize the northern and southern aspects of the sun and his dual sovereignty.

In the center is the King Her-Hor; on the right of the picture are Nekhebit, wearing the southern crown, and Horus offering the same emblem to the king; on the left are Uatchit and Set, respectively wearing and offering to the king the northern crown; over the king is the sun with the two snakes representing the sovereignty of the north and south.

A much-damaged inscription which came from the ancient temple of Memphis, and which purports to have been copied from an older original by order of Shabaka, an Ethiopian king of Egypt (about B. C. 700), tells us of a fight between Horus and Set, which was brought to an end through the mediation of Seb, chief of the gods. Seb declared that there should be an arbitration between the belligerents, and summoned them to a mountain in the desert to the east of Memphis; each stood upon a hillock and there made peace, declaring the nome of An in which they stood to be the boundary of their territories. Seb then ratified the ar-

rangement, and appointed Horus king of the north and Set king of the south. In this there is no allusion to the cause of the combat—no suggestion that Osiris had been slain; and it seems almost certain that the scribe who wrote the account to adorn the walls of the great Memphite temple was unacquainted with the legend of the enmity between Osiris and his brother Set, especially as the death of Osiris is mentioned in another connection in the same inscription. It may also be noted that the pyramid texts, though they speak continually of all three gods, and even occasionally refer to the contest between Horus and Set, never suggest that it was connected with the death of Osiris. We must conclude, then, that the Osirian myth, in the form in which Plutarch gives it, does not belong to the early ages of Egyptian history. Rather was the death of Osiris quite independent of the contest between the two Rehus (the name given by the Egyptians to a pair of gods, such as Horus and Set, Shu and Tefnut, Ra and Tehuti). It is not difficult to understand, however, how, in the process of amalgamation by which the Egyptian Pantheon was formed, the two myths would tend to coalesce and ultimately become fused. But that the new doctrine never altogether ousted the old is curiously illustrated by the position of Isis and Nephthys. Isis was the wife of Osiris, and Nephthys that of Set, and they ought, one would suppose, to be in antagonism; nevertheless, throughout Egyptian history they are the two beloved sisters who stand beside Osiris—the two weepers who mourn his death, and that of the dead man identified with him. This conception is clearly a survival of a much older mythology than that which the Greeks and Romans found in Egypt.

How, then, shall we explain the fight? The most probable suggestion appears to be that it was invented to account for the divided sovereignty. When the "disease of language," mythology, had personified the two aspects of the sun, it was inevitable that stories should arise of how the double kingdom came into being. A fight, followed by the intervention of the great god Seb (or Tehuti, according to another version), and a division of the territory between the combatants, would at once commend itself to the good sense of the early Egyptian. Be that as it may: that the two gods did symbolize for many ages the sovereignty over the north and south is established beyond reasonable doubt. Later on, the antagonism which was originally represented as a mere fight for territory came to be regarded as an allegory of the eternal war between light and darkness, between the Nile and the desert, and even between good and evil. This last stage, which is supposed to have been arrived at under the influence of Persian ideas, was marked by the erasure of the name of Set from the monuments, and the substitution of other names for his in the religious papyri.

The duality of the Pharaoh's kingdom is expressed also by the two goddesses Nekhebit and Uatchit, who are represented usually by a vulture and a uræus, but sometimes by two vultures, sometimes by two uræi, sometimes by snake-headed vultures, and sometimes by winged snakes. From their continually receiving the same epithets as the southern and northern crowns (notably that of "mighty one of magical spells"), and also interchanging with the crowns in different copies of *the same* text, it seems reasonable to infer that they are in fact the crowns personified. Although this may be open to question, it is clear that Nekhebit and Uatchit are goddesses of the south and north. They usually wear the special crowns of their respective territories, they are represented standing on the plants emblematic of the two divisions, they are constantly depicted in close association with the two snakes depending from either side of the sun (who sometimes even bear their names), and they are also found in company with Horus and Set. One piece of sculpture seems to sum up the whole matter very effectively: the king is shown seated between the goddesses Nekhebit and Uatchit, each wearing her appropriate crown; beyond them, on either side, stand Horus and Set offering the two crowns to the king; beyond these again are written the speeches of the gods in making the presentation, and above is the sun's disk with the two uræi (see illustration).

Here we must close this too brief sketch of the myths and symbols that gathered around the sun, and the Pharaoh as his image upon earth. To exhaust the subject would be well-nigh impossible, for, to the Egyptian, the sun was the one grand object of worship—the creator and sustainer of the universe; and concerning him, in his various personifications, myths innumerable were related.

VEGETATION VERSUS LIGHT.

If there is one point in plant culture of more importance than another, it is the question of light. Of course there are other important factors, such as heat and abundance of pure fresh air, and good deep soils and plenty of root moisture, but given all these in proper proportions, they are next to useless without plenty of clear, bright light or sunshine. We have only to read the "Fog Report" prepared for the Royal Horticultural Society of London to recognize the enormous damage that is done to exotic plants under glass at Kew and elsewhere around London by the darkening fogs of the winter season. Of course, apart from mere loss of light in such cases, there are chemical questions as well, since the atmosphere is polluted or poisoned, in fact, by free acids, carbon and other impurities which are imprisoned, as it were, at ground level by the dense blanket of fog clouds that hang overhead. A young essayist wrote down on his examination paper in reply to the question, "What is a fog?" "A fog is a cloud that can't fly away!" and the reply, however funny, is literally true.

In the London nurseries and at Kew the results of a long continued fog are most deplorable; leaves fall off by the wheelbarrow load and flower buds refuse to open and wither away, and hairy or woolly leaved plants especially suffer more than do those having a glossy or smooth surface to their leaves. Then the higher the artificial temperature kept up during dark, foggy weather the more damage is done, so that with a lowering of light we must also imitate nature by lowering the temperature in proportion.

Recent experiments go to prove that ordinary white light, i. e., the full compass or gamut, so to speak, of the spectrum, is that most suitable for vegetation. Under blue or green glass, plants make but little progress toward flowering or fruiting. Of all separate colors the red rays of the spectrum have the most stimulating effects—effects comparable in some ways with those of nitrates or other manures.

Many years ago General Pleasanton glazed his vinery with red or violet colored glass, and the vines so stimulated by the red rays of sunlight bore a very large crop, but it was only a spurt at the expense of materials already formed, as succeeding crops were not better, even if so good, as those usually borne by vines under ordinary white glass. This is the real point of the matter; red glass stimulates growth for a limited period only, just as extra heat and extra manures may do, and the weak points of all the experiments hitherto made with electric light during the night and with colored glasses which admit only certain colored rays of the spectrum lie in their having been conducted for a limited period only. Experiments of this kind to be of any real service, must be continued at least all through the circle of a plant's or a crop's growth from seed to fruiting, or from seed to seed again. By taking any plant well stored with sun energy in the shape of starch, we can obtain certain apparently satisfactory results under electric light, under red and other colored glasses, or by the stimulating effects of certain manures, but such results must always be more or less misleading, as were those of General Pleasanton and his grapevines.

Prof. Marshall Ward has lately delivered some pregnant remarks on light and its effects on vegetation at the Royal Institution. It was pointed out that even in a state of nature there are great differences observable in the appearance and internal conditions of leaves of the same species as grown under the continuous light of an arctic summer and the leaves of the same species as grown on the mountains of Europe, such as the Alps, where the diurnal alternations of day and night prevail. It is not easy to account for such differences, but that they exist even in the same species of plants as grown in greenhouses or frames in two different aspects in the same garden is well known to even the least observant of gardeners to-day. We have heard much of the potentiality of the electric light for forcing vegetables and flowers, but some experiments lately made in Paris throw grave doubts on its efficiency. The fact is, plants must feed, and work and rest just as all other living things must do, and even were this not true, the alternating functions of plants demand sunlight at one period of the twenty-four hours, and absence of light is equally conducive to their functional welfare. Hence we are or need not be surprised to find that plants will not for any length of time do well in continuous light, any more than they will in continual darkness. The leaves of a healthy plant absorb carbonic dioxide from the air, and in sunlight this is turned into starch by the chlorophyl granules, but during night starch is acted on by diastase and is changed into sugar, in which soluble state it is readily carried or attracted along the vascular tissues to flowers, fruits, buds, seeds or tubers wherever it is most requisite at the time. The green leaf is a chemical laboratory, and its products must leave the workshop as fast as they are made, or the leaves naturally enough become overloaded with plant food. Of course, the roots help in sending up water containing earth salts in solution to the leaves, but for the present this fact may be left unconsidered. In the Paris experiments two sets of plants exactly alike were taken, and upon one set the electric light was used day and night, the other set was illuminated in the daytime only, the electric light merely replacing sunlight as it were, the plants being allowed to enjoy natural darkness at night as usual. All other conditions of heat, moisture, food, etc., were identical, but the result of the constant light on one set of plants was peculiar. The "up-all-night" plants, so to speak, absorbed too much food and were of a dense green color; they were stunted in stem and their leaves did not expand properly, while the conducting or vascular bundles were not able to do their work—production had gone on rapidly, but distribution of starch was nearly at a standstill—in a word, the machinery of the plants constantly illuminated was thrown out of gear, as one may say. There is much to be learned on these subtile points of vegetable economy, but it is abundantly evident that plants require darkness and rest at night as well as abundance of food and sunlight during the daytime. The fact that diastase loses its power of transforming starch into sugar in sunshine or bright light is a fact long known to maltsters and others, and this serves to throw a side light on the problems now awaiting solution. The whole matter may be put into a nutshell. When it is merely a case of the rapid development of energy already stored up in the bulbs or stems, it is possible that electric light or colored glasses—red or violet more especially—may be serviceable as temporary expedients, but when it is a question of storing up materials in a plant for future crops, then are Nature's own arrangements as to the alternations of light and darkness the only ones likely to prove permanently efficient in the garden.—F. W. Burbidge, in the Garden.

EDIBLE SNAILS IN EUROPE.*

FRANCE.

Snails are consumed in France in considerable quantities, and the exportations to other countries are not insignificant. The quantity annually shipped to the United States is estimated at 100,000 kilogrammes (220,460 pounds). In 1893, the quantity brought into Paris was 645,000 kilogrammes (1,421,967 pounds), of which only about 18,000 kilogrammes were imported. The sales at the "Halles Centrales" (central markets) amounted to 430,000 kilogrammes, all but 13,000 kilogrammes having been of native production.

The edible snails vary greatly in size. Those most esteemed are the large, white ones; the gray ones, one-third smaller, are regarded as much inferior. The prices at the Paris market during 1893 ranged from 17·90 francs to 18·60 francs ($3.45 to $3.59) per 1,000, that is to say, from 79 to 83·70 francs ($15.25 to $16.15) per 100 kilogrammes (220 pounds). A thousand small snails will weigh from 7 to 10 kilogrammes (15·4 to 22 pounds), and 1,000 large snails, from 18 to 22 kilogrammes (39·7 to 48·5 pounds).

The chief seats of the production of edible snails in France at present are the Department of Jura, Côte d'Or and Basses Alpes. The snails of Burgundy have long been celebrated, but they are no longer produced there on a large scale, the industry having, it is said, been almost destroyed, owing to the treatment of the vines with sulphates. The great majority of the edible snails produced in France are of natural growth, and are picked from the vines in the months of March and April. They are found in immense quantities in various sections. In Provence they thrive famously, especially in the neighborhood of Marseilles, where the chalky formations underlying the soil seem particularly adapted to their life and growth. Mr. Claude M. Thomas, the United States consul at that city, gives the following account of the methods employed in gathering them and preparing them for market:

In the early morning when there is dew, or immediately after a rainfall, the people who undertake to supply the market, and who, in many instances, earn a respectable livelihood thereby, go into the gardens and marshy places and pick them from bushes where they have crawled, or from the ground, as the case may be, the labor at a distance appearing not unlike that known in Kentucky and Indiana as "gathering blackberries."

Absolutely nothing in the nature of cultivation or propagation, as in the case of oysters, has ever been attempted in Provence, though it is affirmed that at Beaune, in Bergundy, and parts of eastern Switzerland, small farms are devoted exclusively to their cultivation for market purposes.

In Marseilles they are largely consumed at the table, and are looked upon by many people as in the nature of luxuries; certain restaurants enjoy a paying clientage, built up by a reputation for their special preparations of escargots. The name escargot is that by which the most desirable sort is generally designated, and the edible snail is so universally denominated in this way that, without investigation, one would suppose the term embraces all varieties, or at least all that are of a character adapted to table purposes. A visit to the market, however, discloses the fact that, while the escargot is much larger and in every sense the most desirable, there are two other varieties, known as limace and limaçon, the former being of medium size and the latter quite small.

When first brought from the garden or field, and while still alive (supposing that they have been secured on the morning of their arrival), they are placed in a bucket, or receptacle of some sort, with top closed, and then kept without food for a period of from five to eight days. Removed from this, they are placed in a mixture of salt and water, or water and vinegar, for perhaps six or eight hours, or longer, if desired, being removed from time to time and thoroughly washed in fresh water. They are then ready for the cooking process, which embraces an addition of almost everything that is tempting, which may or may not be for the purpose of making it easy to lose sight of all but the name of the object under consideration.

The artificial culture of snails is carried on to a considerable extent, but with varying success. They are propagated in the months of August, September and October in prairies, or "parks," prepared expressly for the purpose; at this period they roll themselves up and are fed with cabbages, clover, etc. A large wagon load of cabbages, costing 10 francs ($1.93), given after rains, is sufficient to nourish 100,000 snails.

The snails, when in a natural state, scenting the approach of cold weather, enter the ground, and rolling themselves up, remain in this condition until warm weather sets in. It is the popular tradition that their instinct tells them whether the season will be severe or mild, and that they vary the depth of their descent, accordingly, from 10 to 20 centimeters (about 4 to 8 inches).

The cultivated snails are sheltered during the winter in houses composed of brick or wood. They are gathered in April, May and June.

In summer, snails are shipped to Paris in perforated cases or crates, without leaves or other green stuff. In winter, the cases are wrapped in thick paper.

The cost of preparing them for the market is greater than the cost of producing them, and causes them to be regarded as something of a luxury. They are dressed with a paste or sauce of garlic, fine butter, etc. The total cost of the production of snails at the place of origin is estimated at from 12 to 15 francs ($2.32 to $2.90) per 1,000; the cost of transportation to Paris at from 4 to 6 francs (77 cents to $1.16) per 1,000; average for all sizes, 5 francs (96½ cents) per 1,000. The cost of preparing for market in Paris is from 10 to 20 francs ($1.93 to $3.86) per 1,000. The retail price of prepared snails in Paris is 60 centimes to 1 franc (11⅗ to 19·3 cents) per dozen.

The snails exported to the United States are of the finest quality, and cost from 24 to 25 francs ($4.63 to $4.82) per 1,000. They are exported alive, rolled up naturally. The shipments are chiefly made in November and December. The prepared snails are not exported. The time occupied in transportation to the United States is a serious factor in the traffic.

The most extensive cultivator of snails in France is, as I am advised, M. Gros, of Orgelet, department of the Jura, whose annual output ranges from 1,000,000 to 2,000,000 snails. Among the chief exporters to the United States are M. Dupont, No. 5 Rue Pirouette, Paris, and M. Vidal, No. 11 Boulevard de Charonne, Paris.

The information given in the foregoing was derived from dealers and from official sources. Especial acknowledgment is due M. René Saint Martin, "Inspecteur Principal des Perceptions Municipales," Halles Centrales, Paris. The statistics were derived from "Le Rapport Annuel de l'Année 1893" (Direction des Affaires Municipales sur les Services Municipaus de l'Approvisionnement).

SWITZERLAND.

The business of snail gathering in Switzerland is one which has within the past five years assumed increased importance. Originally the business was confined to the monasteries. The monks collected the snails found in the vicinity of their cloisters and ate them as a delicacy. In time of want and famine, however, instead of a delicacy, snails became, for the monks, the chief article of food. In 1792, according to the kitchen accounts of the monastery of St. Gall, 5,500 snails were purchased by this institution from collectors in the Rhine valley. In 1844 the Capuchin cloister in Appenzell maintained a garden containing from 12,000 to 15,000 snails.

* United States Consular Report.

The kind of snails thus gathered is found in all parts of Switzerland—in the cantons of Wallis, Waadt, Neuchatel, Bern, Freiburg, Aargau, Zurich, St. Gall, and Appenzell. Its scientific name is Helix pomatia.

At the present time, the me hod of obtaining snails in Switzerland is the old and simple one of gathering them from the fields and forests, the forest snails being considered the best. They are, as yet, not regularly propagated to any extent. As the demand for them increases, however, propagation will be resorted to. Already, one collector—Mr. Roman Seiler, of Aarburg, Canton Aargau—has begun to breed them.

The method of preparing snails for the market is substantially as follows: A piece of poor meadow land is chosen, lying toward the north and having in it a few trees. Land on the edge of a forest which the sun does not strike before 10 o'clock A. M. is the most suitable. The soil of this meadow must either contain lime or burnt lime and sand must be strewn over it. It is also of advantage to spread over any large rocks in the field a wash of lime. Around this pasture, thus prepared, it is necessary to build a tight fence, about eighteen inches high. The inside and top of this fence must then be washed with some very rancid oil or iron vitriol, so that the snails may not crawl over it and escape. A row of nails set in the top of this fence will answer the same purpose as the wash of oil or vitriol. A plot of ground, two square yards in area, will accommodate 1,000 snails. For 20,000 or 25,000 snails, a plot 50 square yards in area is necessary.

The time for gathering the snails is from the middle to the end of July, after their eggs have been laid. As fast as gathered, they are placed in the meadow or snail garden. Loose moss is then strewn along the fence, or else a low awning of boards constructed, under which the snails may escape from the too great heat of the sun. The trees in the pasture also are of great service in affording shade.

During dry weather, the snails need not be fed, but with the coming of rain food must be provided. This may consist of salad, cabbage, kitchen waste, or wheat bran. The lion tooth, the common nettle, and field hemp may also be used. A prepared food can be bought, which is excellent, and causes the snails to fatten rapidly. In the latter part of August, or early in September, the whole pasture must be loosely covered with moss, under which the snails secrete themselves until the time of removal for market, which is the beginning of cold weather, and after their shells are matured. None are kept through the winter.

The quality of the snail in the market is determined by the appearance of the shell. If this is glossy and well rounded, the snail is known to be fat and good.

In order to be shipped the snails are packed in wooden cases or barrels, from 1,000 to 2,000 (sometimes 5,000) in a single package. The material to be used for keeping them apart is hay or fine shavings. Snails can be shipped with safety only in cold weather, as, when the weather is warm, they emerge from their shells and by their combined pressure burst open the strongest cases.

From Switzerland, snails are sent to Belgium, France, Italy, and Holland. The most of them go to Paris. I cannot discover that any are shipped to the United States. Mr. Roman Seiler (the gentleman already alluded to as experimenting in the breeding of snails) writes me that five years ago he sold with difficulty 84,000 snails, but that in 1893 he could have disposed of one hundred times as many. On all sides, the demand for snails, as an article of food, is increasing. The wholesale price of snails in Switzerland is about 24 centimes (5 cents) a dozen. In Paris, it is about 36 centimes (7 cents). Zurich is the canton from which snails are chiefly exported.

THE SHADE TREE INSECT PROBLEM IN THE EASTERN UNITED STATES.*

THE space at command will not admit of a full treatment of the problem outlined in the title of this article, and the writer has therefore brought together at this time some account of three species which are perhaps the most destructive among shade tree insects, or which, at all events, have attracted the greatest attention during the past season. To this he has added a brief consideration of the relative immunity of shade trees from insect attack, and some remarks on the subject of general work against shade tree insects in cities and towns.

One of the most striking features of the summer of 1895 has been the great abundance in many Eastern cities of several species of insects which attack shade trees. In almost every low lying town from Charlotte, N. C., north to Albany, N. Y., the elm leaf beetle has defoliated the English elms and, in many cases, the American elms. In certain directions this insect has also extended its northern range, notably up the Connecticut River Valley. The authorities in a number of Eastern cities have taken the alarm, and active remedial work will be instituted during the coming season. In cities south of New York the bagworm has been gradually increasing for a number of years until it has become a serious enemy to shade and ornamental trees for almost the first time since 1879 or 1880 (Figs. 1 and 2). The white marked tussock moth, the caterpillar of which has been for many years the most serious of the shade tree pests in Philadelphia, New York, Brooklyn and Boston, in 1895, for the first time within the recollection of the writer, appeared in such numbers as to become of great importance in more southern cities, as Baltimore and Washington. The fall webworm, Figs. 9, 10 and 11, was more abundant in Washington and the surrounding country than it has been since the summer of 1886.

These four insects are the principal shade tree defoliators in the Eastern States, if we except the imported gypsy moth, which is at present fortunately confined to the immediate vicinity of Boston, and is being cared for by a thoroughly capable State commission. While the summer of 1895 may with justice be called an exceptional one as regards the great increase of numbers, yet these insects are always present and do a certain amount of damage each season, and when an exceptional season comes, as it did this year, city authorities seldom find themselves prepared to engage in an intelligent and comprehensive fight.

In cities farther west other leaf feeders take the place of those just mentioned. The principal ones are, perhaps, the oak Edema, the cottonwood leaf beetle, and the green striped maple worm.

Several scale insects or bark lice are occasionally serious enemies to shade trees. Maples suffer especially from their attacks. The cottony maple scale is found everywhere on all varieties of maple, and occasionally in excessive abundance. The cottony maple leaf scale, a species imported from Europe, is rapidly gaining in importance, and in several New England towns it has, during the past season, seriously reduced the vitality of many trees. The so-called "gloomy scale" has long been on the increase in Washington, D. C., and every year it kills large branches and even entire trees of the silver maples, which are so extensively grown along the streets of that city.

Certain borers are also occasionally destructive to many shade trees, and, in fact, in the northern tier of States, these are the most important of the shade tree enemies, the principal leaf feeders being either absent or becoming single brooded. Where absent their places are taken by less destructive species.

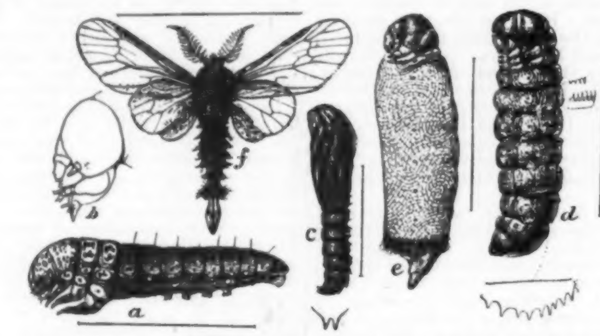


FIG. 1—Bagworm (Thyridopteryx ephemeræformis). a, larva; b, head of same; c, male pupa; d, female pupa; e, adult female; f, adult male—all enlarged (original).

In fact, it is safe to say that shade trees suffer especially from insect attack throughout the region of country which is contained in the Upper Austral life zone.*

Concerning the borers, it may be briefly said that these insects rarely attack vigorous and healthy trees, but should a shade tree lose its health through the attacks of scale insects, through rapid defoliation by leaf feeders, or through a leaky gas main or sewer pipe, different species of borers will at once attack and destroy it. There is one particular exception to this rule, and that is the European leopard moth, a most destructive species, which is at present of very limited range and confined to the immediate vicinity of New York City. No certain information is at hand which indicates that it has spread for more than 50 miles from the center of introduction. This insect attacks healthy trees, boring into the trunks of the younger ones, and into the branches and smaller limbs of many shade and fruit trees. It is an extremely difficult species to fight, and it is fortunate that its spread is not more rapid.

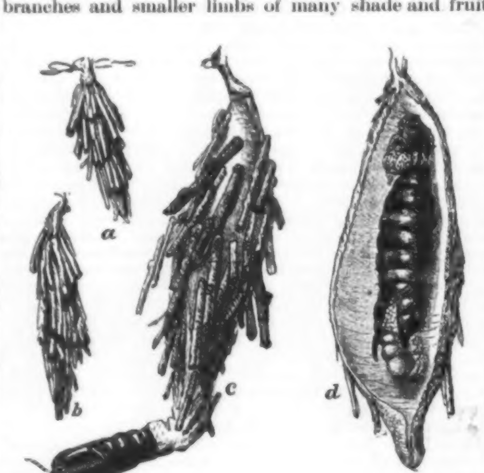


FIG. 2.—Bagworm at (a, b, c) successive stages of growth. c, male bag; d, female bag—natural size (original).

THE IMPORTED ELM LEAF BEETLE.

(Galerucella luteola Müll.)

Original Home and Present Distribution.—The imported elm leaf beetle (Fig. 3) is a native of southern Europe and the Mediterranean islands. It is abundant and destructive in the southern parts of France and Germany, and in Italy and Austria. This beetle is found, though rarely, in England, Sweden, and north Germany, and gradually becomes less numerous and destructive toward the north. In middle Germany it is common, though not especially destructive. As early as 1837 it was imported into the United States at Baltimore, and is now found as far south as Charlotte, N. C. From this point it ranges northward in the Atlantic cities as far as Providence, R. I. Inland it has not passed the barrier of the Appalachian chain of mountains, and is practically confined to the Upper Austral region, as indicated in the map on page 210 of the Yearbook for 1894. Thus, up the Hudson River it has spread to Albany, N. Y., but on either side of the river, as the land rises into the foothills, it has stopped. In the same way it has more recently spread up the Connecticut River Valley to a point north of the New Hampshire State line, and also, to a less extent, up the Housatonic Valley. From our present knowledge it seems likely that its future spread as an especially destructive species will be limited by the northern border of the Upper Austral region, and that (as may happen at any time) should it once be carried by railway train across the southern extension of the Transition life zone, caused by the Alleghany and Blue Ridge mountains, it will spread unchecked through Ohio, Indiana, Kentucky, Tennessee, and other Western States.*

Food Plants.—No food plants other than elms are known. The common English elm (Ulmus campestris) is its favorite food, and the gardener's variety, the so-called Camperdown, or weeping elm, is attacked with equal avidity. The American, or white, elm (U. Americana) ranks next among the favorite species, with U. Montana, U. suberosa, U. flava, U. racemosa, and U. alata in about the order named. No variety seems absolutely exempt. In the presence of U. campestris other elms are seldom seriously injured. Where campestris is absent, or where a single tree of campestris is surrounded by many American elms, the latter become seriously attacked.†

Life History and Habits.—The elm leaf beetle passes the winter in the adult, or beetle, condition in cracks in fences or telegraph poles, under the loose bark of trees, inside window blinds in unoccupied houses, in barns, and, in fact, wherever it can secure shelter. As soon as the buds of the trees begin to swell in the spring the beetles issue from their winter quarters and mate, and as soon as the buds burst they begin to feed upon the leaflets.

This feeding is continued by the beetles until the leaves are fairly well grown, and during the latter part of this feeding period the females are engaged in laying their eggs. The eggs (Fig. 3, c) are placed on the lower sides of the leaves, in vertical clusters of 5 to 20 or more, arranged in two or three irregular rows. They are elongate oval in shape, tapering to a rather obtuse point, orange yellow in color, and the surface is covered with beautiful hexagonal reticulations. These reticulations, however, can be seen only with a high magnifying power.

The egg state lasts about a week. The larvæ (Fig. 3, d) as soon as hatched feed on the under surface of the leaf, gradually skeletonizing it. They reach full growth in from fifteen to twenty days, and then either crawl down the trunk of the tree to the surface of the ground or drop from the extremities of overhanging branches. At the surface of the ground they transform to naked, light orange colored pupæ (Fig. 3, g), a little over a quarter of an inch in length, and in this stage they remain for from six to ten days, at the expiration of that time transforming to beetles. The pupæ will frequently be found collected in masses at the surface of the ground in this way. On very large trees with shaggy bark many larvæ will transform to pupæ under the bark scales, or on trees of the largest size they may descend the main branches to the crotch and transform unprotected in the hollow of the crotch.

The larva is elongate, reaching when full grown (Fig. 3, e) half an inch in length. When first hatched it is nearly black; as it increases in size it becomes, with each shedding of the skin, more distinctly marked with yellow, and when mature the yellow predominates, occurring as a broad dorsal stripe and two lateral stripes.

The difference between the early work of the beetles and the later work of the larvæ is recognized at a glance. The beetles eat entirely through the leaves and make complete, irregular holes, while the larvæ simply eat the parenchyma from below, skeletonizing the leaf.

The time occupied in egg laying is long, and it thus happens that at the time when full grown larvæ, and even pupæ, are to be found, there are also upon the leaves freshly laid eggs.

In Washington there are invariably two generations annually, the beetles developed from the eggs laid by the overwintered beetles themselves laying their eggs in July. The adults issuing from these eggs make their appearance in August. Farther north, at New Brunswick, N. J., and in the Connecticut cities, it may be said that there is normally a complete first generation and an incomplete second generation.

The proper food of the larvæ is the rather young and tender leaves. If the work of the first generation has not been complete, and the trees have not been so nearly defoliated as to necessitate the sending out of fresh leaves, or if a period of drought ensues after defoliation and prevents the putting out of a second crop of leaves, the beetles of the first generation do not lay eggs, but after flying about for a time seek winter quarters. This may occur as early as the middle of July. Where, however, defoliation has been complete and has been followed by a period of sufficient moisture to enable a tree to put out a fresh crop of leaves, the beetles of the first generation will lay their eggs and a second generation of larvæ will develop upon this com-

* By L. O. Howard, M.S., Entomologist United States Department of Agriculture. [Reprinted from the Yearbook of the United States Department of Agriculture for 1895.]

* Briefly defined by Dr. Merriam in his summary article on "The geographic distribution of animals and plants in North America," in the Yearbook of this Department for 1894, page 208.

* Since this was written the writer has learned that this passage of the Blue Ridge barrier has actually taken place during the past season. Mr A. D. Hopkins, of the West Virginia Agricultural Experiment Station, has found that this insect has established itself at Elmgrove, in Ohio County, and at Wellsburg, in Brooke County, West Virginia.

† The beetles rarely oviposit upon Zelcova carpiniafolia and Z acuminata on the Department grounds at Washington.

paratively tender foliage. Where similar conditions prevail in Washington and its vicinity, a third generation of larvæ may develop, though small in numbers, but the writer is convinced that even in Washington late developing beetles of the first generation may hibernate.

Remedies.—The only thoroughly satisfactory safeguard against this insect consists in spraying the trees with an arsenical solution. The only other remedy which is worthy of mention is the destruction of the larvæ at the surface of the ground before or after they transform to pupæ. The latter remedy, however, is not complete, and even where it is carefully carried out for every tree in a city, it will do no more than reduce the numbers of the insects by perhaps two-thirds.

Ten years ago a proposal to spray the enormous elms which are to be found in many Northern towns would have been received with ridicule, but of recent years the practicability of the plan has so frequently been demonstrated that there is no hesitancy in commending it to more general city use. Probably the largest elm tree in America, the Dexter elm, at Medford, Mass., has been successfully and economically sprayed by the Gypsy Moth Commission. It is necessary to have especial apparatus constructed, and it is equally necessary to have the work done by men who are accustomed to it or at least are good climbers. The first successful work of this kind was probably that done by Prof. John B. Smith on the campus of Rutgers College. He had a strong barrel pump, and carried the nozzle at the end of a long rubber tube, with a bamboo extension pole, up into the center of the trees by climbing a ladder to the main crotch. From this point the spray was thrown in all directions, and the tree was thoroughly coated with the mixture in a minimum of time.

The Gypsy Moth Commission, in their earlier spraying work, sent their large tank carts through the streets, stopping at each tree and sending one or more men with hose and extension poles into it, thus covering hundreds of large trees in a single day. If steam sprayers are used (and the town or city fire engines can be and have been used to excellent advantage in this way), the necessity for climbing the trees may be largely avoided. By means of multiple discharge hose both sides of a tree, or even of two trees, may be sprayed at once, and the extent of territory that may be covered in a day is surprising. The elm trees in a small park may be treated economically and without much difficulty by two or three men with a handcart tank. This method has been adopted on the large grounds of the Department of Agriculture, with absolute success.

The writer's experience at Washington leads to the conclusion that it is important to spray trees once just after the buds have burst. This spraying is directed against the over wintered beetles. If a large proportion of these beetles can be destroyed by poisoning the leaves which they eat, not only will a great deal of leaf perforation by the beetles themselves be prevented, but the number of eggs laid will be very greatly lessened. A second spraying should be conducted two weeks later. This is directed against the larvæ, the majority of which will perhaps have hatched by that time or soon after. A third spraying, and even a fourth, or under exceptional circumstances a fifth, may be required if it is considered necessary to keep the trees fresh and green, and particularly if the earlier sprayings have been followed by rains, as is apt to be the case in the earlier part of the season. In Bridgeport, Conn., where only a part of the trees are sprayed, and these by private enterprise, an even greater number of operations have been found desirable. Three thorough sprayings of all the trees in a given precinct will probably be as much as will be required, especially if this be done year after year and some pains be taken to destroy such of the larvæ as may successfully develop and descend for transformation. Even two sprayings, covering all the elms of a city or town, will be well worth the expense.

The substance to be used in these spraying operations may be Paris green, London purple, or arsenate of lead. The directions for the use of these substances have been so often repeated that it is not worth while to mention them here.

The other remedy—the destruction of the descending larvæ and the quiescent pupæ—is, as above stated, and must always be, incomplete. The standard kerosene emulsion, diluted one part to five parts of water, will destroy the insects in either of these stages. This has been successfully used in several New England towns the past season, particularly in New Haven. It must be applied to the base of the trunk and under the entire limb spread of the tree. The rough bark must be removed to a slight extent (the writer does not advocate severe scraping), leaving as few crevices as possible which may harbor the pupating insects. If a tree is very large, it will pay occasionally to climb into the main crotch and destroy such individuals as may have collected at that point. Experience leads us to estimate that on large trees not more than one-half to two-thirds of the larvæ reach the base of the trunk and transform at that point. The extent to which larvæ drop from overhanging branches has been questioned, and it is sometimes a difficult matter to decide. The city forester of Springfield, Mass., however, called our attention to a peculiar and eminently satisfactory case where the drooping branches of a large elm extended completely over a house, on the other side of which there were no elm trees. On the far side of the house beneath the tips of the overhanging branches, the larvæ and pupæ were collected in large numbers in the summer of 1895.

(To be continued.)

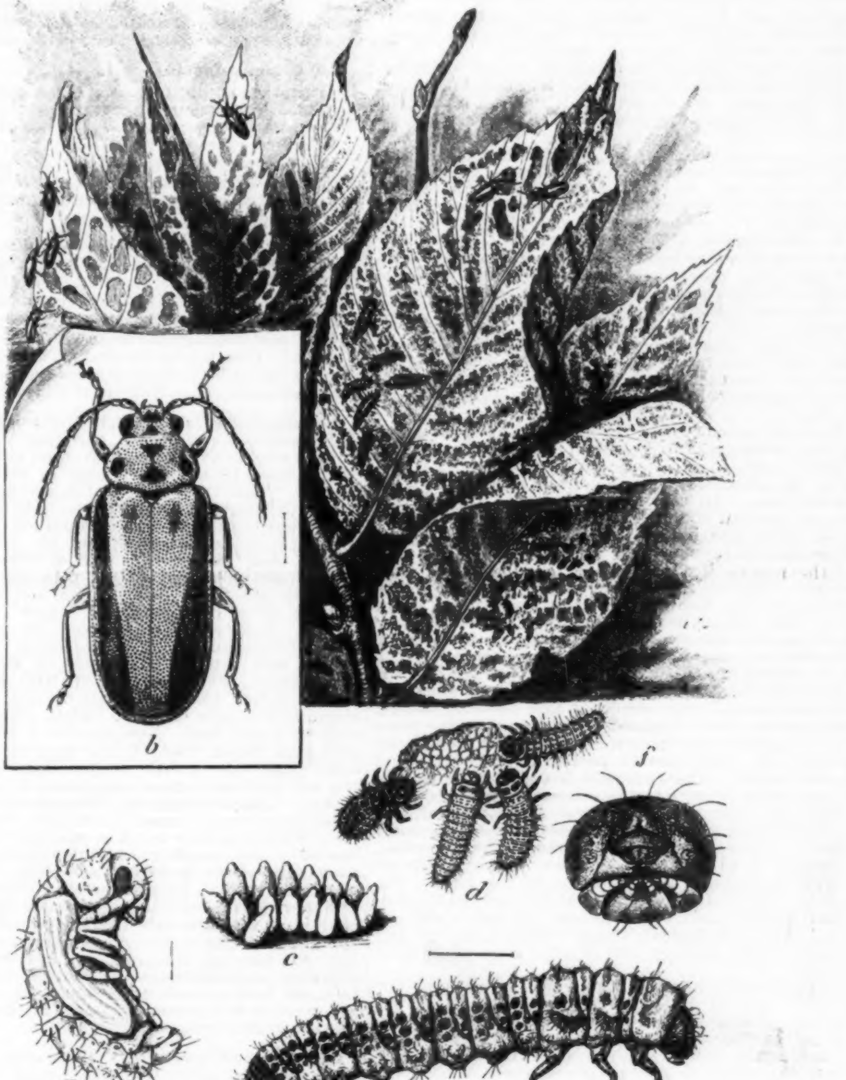


FIG. 3.—The Imported Elm Leaf Beetle (Galerucella luteola). a, foliage of European elm, showing method of work of beetle and larva—natural size; b, adult beetle; c, egg mass; d, young larva; e, full grown larva; g, pupa—all greatly enlarged; f, mouth parts of full grown larva—still more enlarged (original).

FREAKS, AS PERTAINING TO DISEASES OF THE SKIN.*

By JAMES C. MCGUIRE, M.D., Washington, D. C.

IT is not alone in post graduate schools and hospitals we should look for clinical material; the dime museums of our large cities, the side shows of the circus, furnish excellent advantages for instruction. Especially is this true as regards skin diseases. Many anomalous examples of cutaneous lesions, that would be difficult to find elsewhere, are here seen to their best advantage; for, as a rule, the disfiguring lesions have not been treated in any way; more likely still are they to have been cultivated, till they are in full bloom. It may be of interest to cite a few of these cases and—instructive from a scientific standpoint—to properly classify them as diseases.

The popular names given to many of these deformities are given them on account of their resemblance to the skin of lower animals, as the "alligator boy," the "elephant man," "elephant leg," the "fish-skin girl," the "dog-face boy," the "leopard boy," etc. Others are designated as the "elastic skin man," the "bearded lady," the "blood sweater," the "albinos," the "man with horns," the "blue man," etc.

The "alligator boy," the "fish-skin girl," the "porcupine man," the "hedgehog man," all suffer from different manifestations of the same disease. The appearance of the skin so closely resembles that of fishes it is designated as ichthyosis; it is a congenital chronic disease, characterized by dryness, harshness, and scaling; usually showing itself within twelve or sixteen months after birth. In the milder form, known as xeroderma, there is only slight scaling, but the natural furrows of the cuticle are much exaggerated. In some pronounced cases, the skin is divided into diamond shaped figures, and scales appear in abundance—white or dark green in color—and are especially adherent in the center. These are the cases to which the terms "fish skin," "snake skin," are applied.

In the most severe manifestations of the disease, designated as ichthyosis hystrix, the hypertrophied skin may present dark, corrugated, wrinkled masses, resembling the bark of a tree rather than fish scales. There may be spinous or quilled excrescences, as in those cases designated as "porcupine men," "hedgehog men."

A very remarkable case of ichthyosis hystrix was shown at the Royal Society, March 16, 1731, reported by Dr. McColl Anderson.† The patient was fourteen years of age. "His skin (if it might be so called) seemed rather like a dusky colored thick case, exactly fitting every part of his body, made of rugged bark or hide, with bristles in some places. It did not bleed when cut or scarified, being callous and insensible. It was said he shed it once a year. It is not easy to think of any sort of skin that exactly resembled it; some compared it to the bark of a tree; others thought it looked like seal skin; others like the hide of an elephant. The bristly parts, which were chiefly about the belly and flanks, looked and rustled like the bristles or quills of a hedgehog, shorn off within an inch of the skin. The patient was again shown twenty-four years later by Mr. Henry Baker, still presenting the same deformity. He had had six children, all of them presenting exactly the same deformity. 'It appears, then,' said Mr. Baker, 'past all doubt, that a race of people may be propagated by this man having such rugged coats or coverings as himself.'"

Dr. G. H. Fox reports‡ an interesting case of ichthyosis—the "alligator boy." The article is accompanied with two excellent colored plates.

There is still another rare form of the disease, known as ichthyosis congenita. Some authorities—Hebra, Kaposi, and others—regard it as a distinct affection, consisting in a perverted secretion of the vernix caseosa. It is said to begin at an early period of intra-uterine life. At birth, the skin appears too tight, for the body is deeply fissured and hypertrophied, resembling plates of armor; to this form of the disease the term harlequin fœtus has been applied.

One of the most common of the freak family is the albino, a name given to those who suffer from a partial or complete loss of pigment, of congenital origin; it is said to be seldom met with in the white race; not only is there loss of pigment from the cutaneous covering, but the hairs and choroid coat of the eyes are affected as well. The white mice and birds of this climate are examples of albinismus.

The "leopard girl" is affected with leucoderma, a word derived from the Greek, meaning white skin; the term vitiligo—a blemish—is also applied to the deformity. It differs from albinismus from the fact that it is acquired and not congenital. The loss of pigment occurs in patches more or less numerous, that may run together till the whole skin is affected; the hairs on the affected patches also turn white. As to causation, it is said to be due to "disturbance of innervation." Many cases have been on exhibition; and it is not unusual to see it on the hands and face of negroes in this city. In the Louisville Medical News, 1880, Dr. Hall refers to a dark mulatto who became perfectly white, except a patch on the chin.

Leucoderma also affects the lower animals, as in the case of the "sacred white elephant." They are not really white, but of a pale flesh color. We will not look upon these sacred animals with such reverence when we learn the condition may be produced by artificial means. Dr. Piffard has witnessed the experiment of bleaching the skin of the ordinary elephant, by means of peroxide of hydrogen; it was applied several times a day; at the end of four days, the hide had changed to a light ash color, but he did not believe it would be permanent.

There have been several elastic skin men on exhibition; the best known of them is Herr Hagg, who could pull the skin from his chest up to his eyes. Meekren, as long ago as 1657, records a patient who could bring the skin of his chest up to his eyes and down to his knees. These cases are a form of dermatolysis, a rare deformity, that is owing to some defect in the attachment of the cuticle. It is a congenital affection, though it is said the ability to move the skin is increased by cultivation. Other forms of the disease occur in the

* Read before the Medical Society of the District of Columbia, February 19, 1896.

† Diseases of the Skin, 1887.

‡ Journal of Cutan. and Vener. Dis., April, 1884.

abnormal growth of skin, attended with thickening; the integument hangs in folds and overlapping layers. An excellent example of this is seen in plate No. 7, Van Harlingen's Handbook of Skin Diseases. All of the above cases have several peculiarities in common; the deformities are not amenable to treatment; the general health is, as a rule, not affected, and practically nothing is known of the causation of the deformities beyond the fact of inherited tendency.

The "blue man" may be suffering from a condition known as cyanosis, defined in Foster's dictionary as a "bluish discoloration of the skin from defective aeration of the blood, either temporary, as in asphyxia, or permanently, as in the subjects of some malformation of the heart, especially persistent patency of the foramen ovale; or the blue man's condition may have been brought about by the ingestion of nitrate of silver."

An extremely interesting case, occurring without assignable cause, is reported by Mitchell Bruce (Inter. Atlas of Rare Skin Diseases). The patient was a harness maker, 49 years of age; the condition affects the body generally. He suffers from intermittent pains of burning, shooting character, chiefly in the epigastrium and left lumbar region. Pains and discoloration commenced two years previous to his admittance to the hospital, and though under observation for three months, there was no change. There was nothing in the patient's occupation to account for the discoloration.

A few years ago a man exhibited himself in a New York museum, with a horn growing from his forehead; it resembled an animal's horn in respect to shape and size, but was of a dark grayish color, and rough and harsh to the feel. This condition, known as cornu cutaneum, may occur on any part of the body and be of any shape and number; they differ from similar appendages in cattle, from the fact that, in these animals, the horn grows only from osseous tissue. There is a specimen in the British Museum that is said to measure 11 in. in length by 2½ in circumference. Lebert, in 1864, reports 109 cases he had compiled from different sources; in 12 per cent. of these cases it gave rise to consecutive epithelioma.

"Elephant leg," "Barbadoes leg," is the well known disease elephantiasis arabum. Kaposi defines it as an "hypertrophy of the cutis and subcutaneous cellular tissue, which is confined to some region of the body, due to local circulatory disturbances." The most frequent seat of the disturbance is the lower extremity; rarely are both limbs affected. At first there is a deep seated inflammation that leaves the parts in a swollen edematous condition. Every few months this is repeated, leaving the leg still more swollen, till it reaches such enormous proportions as even to interfere with locomotion; the surface may be smooth or warty; sometimes the bones are affected.

An interesting case allied to this disease is described in the British Medical Journal, December 11, 1886, under the name of the "Elephant Man," a most remarkable case of congenital deformity of the skin and bone. The bony exostosis on his frontal bone, combined with a deformity on the superior maxilla, gives a trunk-like appearance to the nose and upper lip, the profile of the face suggesting the profile of an elephant's head. "The tissue is very loose, so that it can be raised from the deeper parts in great folds. The cranial bones are deformed and overgrown, so that the circumference of the patient's head equals that of his waist. Bony exostoses spring from the frontal bone, the posterior part of the parietals and the occipital." The patient can give no family history of similar deformity, but declares his mother was knocked down by an elephant when bearing him. The papillary excrescences are increasing rapidly, and hypertrophy of the integuments of the right hand is causing it to become slowly crippled; general health good.

"Hide-bound skin" is recognized as scleroderma, a chronic inflammatory disease, characterized by a hardening and rigidity of the cuticle over areas of greater or less extent; the surface may be white, yellowish, or even bronze color; the skin may become shrunken and depressed; when limited in extent it is known as morphea, though some authorities consider the latter an independent disease. The disease is supposed to be due to "disorders of the nervous system."

There are some anomalous conditions of the integument which may not be out of place to refer to in this article; though, as a rule, the subjects do not exhibit themselves, they are none the less interesting. In my personal experience, I knew of a young woman, in excellent health, without blemish upon her skin, who exhaled an odor so much like violets it had been remarked upon; in consequence, she is in the habit of wearing violets, or to have an artificial perfume of that flower about her person. The odor is always accompanied with excessive sweating; the perspiration is so excessive she will soil several pairs of gloves during an evening's dance. The condition is usually designated bromidrosis (stinking sweat), but in this case a better name is osmidrosis.

Colored sweat, known as chromidrosis, is usually feigned, but there have been a few well authenticated cases reported. The condition may be due to the growth of micro-organisms; it may also be caused by the medicine the patient is taking, as in Dr. Taylor's case, when blue sweat occurred in a man taking iodide of potash. The condition is supposed to have been brought about by the reaction of the iodine in the perspiration and the starch in the patient's shirt. Occasionally we read in newspapers of hysterical females and religious fanatics "sweating blood;" this is known as hæmatidroses. Kaposi declares this is not the true sweating of blood, "but the occasional nontraumatic exit of arterial blood from the pores of the skin." In his work on "Diseases of the Skin" he refers to a case observed by Hebra, who once saw a spiral stream of blood spurt from the opening of a sweat gland on the dorsum of a young man's hand. A few cases of phosphorescent sweat have been recorded, though it is said to be caused by fish diet. S. Pollitzer considers it not unlikely that the phosphorescence is due to action of phosphoric bacilli, many varieties of which have been described.

That this article may be fully up to date we will mention those cases in which objects, such as trees, are indelibly impressed upon the skin of those who have been struck by lightning. Prof. Wright, of Yale University, declares that these images are photographed by means of the cathode rays, of which we have recently heard so much. Some years ago, a lady, living in New York, stated to me that the dark ring about her wrist was caused in this way. While she and her family were sitting at the dinner table, during a severe thunder storm, the window being open, "a ball of fire entered and knocked us all senseless; it was some time before I recovered from the shock, when I found the image of a bracelet which I wore was photographed upon my wrist."

It is, of course, a recognized fact that the hair may be whitened long before the time it would naturally occur from senile changes. Lord Byron, in the Prisoner of Chillon, refers to this condition:

"My hair is gray, though not with years,
Nor grew it white
In a single night,
As men's have grown from sudden fears."

History records, but on doubtful authority, that the hair of Sir Thomas Moore and Marie Antoinette turned suddenly white the night before their execution; that Henry of Navarre was so shocked on hearing that the edict of Nemours was conceded, the hair of his moustache whitened in the course of a few hours. Even if we do not accept these cases as authentic, there have been many others recorded in recent times by competent observers; so that sudden blanching of the hair under great mental emotion is considered a possible but extremely rare occurrence, by all authorities whom I have consulted except Prof. Kaposi, of Verina. He declares that though grayness of the hair may occur in a short time, he does not believe it can occur suddenly and in fully developed hair; the reported cases he considers are based on "errors of observation." Dr. Jackson and others declare the condition is due to the formation of air bubbles between the hair cells of the cortical substance; the air renders it opaque, so that the color of the pigment is obscured. Kaposi's views do not coincide with these; he believes grayness is due to loss of pigment, and does not consider the influence of fright or mental emotion of any kind cause gases to develop in the hair, and that these gases or air conceal the pigment; inasmuch as many normally colored hairs contain air.

Notwithstanding the negative views expressed by such an excellent authority as Prof. Kaposi, that sudden blanching may occur has been proven beyond a doubt, not only in man, but the lower animals as well. Sir Erasmus Wilson mentions the experiments of Sir John Ross. He exposed a lemming—a kind of rat—to the open air at the temperature of thirty degrees below zero; the next morning the fur of the cheeks and spots upon each shoulder had become white; within a week the animal was perfectly white except a small patch on the back.

There has recently been reported a case the reverse of canities, where gray hair suddenly became black.

There is also a rare condition of the hair in which there are alternate rings, one white, the other the natural color. In the Londen Lancet, 1881, Squire gives an account of a boy sixteen years old, one side of whose head was piebald like a tortoiseshell cat, the other side dark brown.

As has already been said, loss of pigments may occur elsewhere than on the skin and hair. The nails of the hand have been known to become as white as snow. Dr. S. Giovaninni, in the International Atlas of Rare Skin Diseases, describes a case of this kind, which he calls canities unguium. An abbreviated report of the case is as follows: Coachman, 29 years of age: all the nails on the fingers are milk white in appearance, but otherwise normal; the condition first occurred during convalescence from typhoid fever, when twelve years old; the second and third toes of each foot are webbed (syndactylia), otherwise the patient is well formed and in good health. The condition is supposed to be due to penetration of air into the interior of the nails, practically the same condition that occurs in canities. Dr. G. P. Unna has reported a second case in the same Atlas. To it he has applied the name of leuconcychia, preferring it to the term canities, which he thinks should be confined to blanching of the hair. The patient, twenty-six years of age, at first noticed the condition when a child. In this case the hair is also affected. The pathological changes consist in dryness and lack of luster of the hair, and of white rings of different sizes.

The "bearded women" that grace so many of the museums by their presence must not be left out of this collection of freaks. These females are afflicted with a deformity rather than a disease, known as hypertrichosis, or hirsuties, which simply means a growth of hair abnormal in amount, or grows in places where lanugo hairs are normally found. Chowns speaks of a boy eight years of age who had the whiskers of a man. Dr. Cummins mentions the case of a lady who was noted for the beauty of her face, whose body, from breast to knee, was covered with a profusion of black, thick, bristly hair. These cases and others are referred to in Dr. Jackson's Diseases of the Skin. He says partial congenital hypertrichosis is apt to be of the nature of nævus.

The distinction between the localized hypertrichosis and nævus is mostly made upon the color of the underlying skin. In the former case the skin is perfectly normal, while in the latter it is pigmented, and may be otherwise altered.

The Russian "dog-man," from Ziemssen's Handbook of Diseases of the Skin, is the best known specimen of homines pilosi. Exactly the opposite condition is the universal loss of hair, known as alopecia universalis. Dr. Ohmann-Dumesnil, in the quarterly Atlas of Dermatology, January, 1896, reports a case of this kind. All the hairs of the body were lost, even the fine downy ones known as lanugo hairs. The process was slow and insidious. He says: "As thoroughly a naked individual as could be imagined is a result of the effect of this universal process."

The last freak that will be referred to in this article is probably the most unique of all. It is known as phagmesis, in which feathers adorn the body instead of hair. Dr. G. T. Jackson, in his most excellent treatise on Diseases of the Skin and Hair, is responsible for the following statement: "Dr. T. Robinson cites a case of this nature which occurred in a boy who was exhibited at Bremen, and was reported upon in Bauerle's Magazine for 1831. The boy's head is said to have been covered with feathers in place of hair."—Va. Med. Semi-Monthly.

SELECTED FORMULÆ.

Restoring German Gilt.—The following varnish is useful for restoring tarnished German gilt picture frame moulding:

Gamboge	30 grains.
Dragon's blood	240 "

Powder the above and then add:

Turmeric	30 grains.
Shellac	2½ ounces.
Sandarac	2½ "

Place the whole of the above in a bottle, and add two ounces dry oil of turpentine; shake often, keeping in a warm place for fourteen days; filter, and add four ounces clear mastic varnish as above.—Canadian Pharmacist.

Remedy for Codlin Moth on Apple Trees.—One pound Paris green, one pound lime, 250 gallons of water; or, better still, equal parts of Bordeaux mixture and Paris green. Used as a spray.—Gardener's Chronicle.

A Matt Black for Iron.—According to the Revue Suisse de Photographie, a matt black surface on iron can be obtained by the use of the following solution:

Mercuric chloride	2 parts.
Cupric chloride	1 part.
Hydrochloric acid	6 parts.
Alcohol	5 "
Water	50 "

The article is carefully cleaned and immersed in the above, or a brush may be used for its application, after which it must be well soaked in hot water. A second application can be given if the color is not dark enough.

Nail Cleaning Liquid.—

Tartaric acid	1 drachm.
Tincture myrrh	1 "
Eau de Cologne	2 drachms.
Distilled water	3 ounces.

Dissolve the acid in the water; mix the tincture of myrrh and eau de Cologne, and add to the acid solution. Dip the nails in this solution, wipe, and polish with a chamois pad.

NAIL POLISHING POWDER.

Fine putty powder	4 drachms.
Carmine	2 grains.
Otto of rose	1 drop.

Very carefully reduce the carmine with the putty powder, and rub together until a homogeneous mixture is formed; then mix in the otto. The nails should be damped, and a little of the powder put on; then polish with a chamois pad.—Bulletin of Pharmacy.

Oxidizing and Blacking Bright Steelwork.—The following direction for oxidizing and blacking the bright work of steel in lieu of paint, to stand heat and to wear well, is taken from a recent issue of the English Mechanic: "Take three ounces of glacial acetic acid, mix it with its weight of water; to this add half an ounce of powdered nut galls, and let stand for a day or two, shaking it up occasionally; then let settle, then pour off the clear, then put a pint of water to the residue. When cold and settled, pour off the clear and mix with the first. Now to this add a grain of nitrate of silver, or sulphate of copper or nitrate of copper. Dissolve whichever you use in a little hot water before mixing with the other liquid. Silver is the best process. Clean all oil off and rust or scabs, paint, etc. Clean all up with bright pumice stone powder. Don't use emery in any form, but the above with a piece of wood. Then clean all off; dry with air slaked lime. Now go over it with the liquid with some cotton wool. If you have saved your powdered galls, take a little of that upon your wool, and you will find that a great acquisition in the first application. Let stand until dry, then give it another coat. When dry, scratch, brush it, and give it another coat, etc. When you have got it to your liking give it some linseed oil and camphor. All bright iron parts can be made like ebony polished, and with the gun-metal mounting you will have a picture in black and gold. Cylinder covers, etc., can be done the same; but you must wash with hot water before oiling it. It will stand any amount of heat, the hammer and friction in wiping; you have no blistering, and you will have some difficulty in eradicating it. Bicycles, repairs, handle bars, etc., can be treated the same way to advantage, well washed with hot water; when dry give them a coat of good copal carriage varnish."

Cement for Porcelain.—1. To cement porcelain to metal, make a mixture of equal parts of water and alcohol (95 per cent. strength), and use this fluid to make a paste with ten ounces finely powdered chalk and eight ounces starch. Then mix in three ounces of Venice turpentine. 2. An excellent cement for china and porcelain may be obtained by melting together seventy-five grains of fish-glue and five drachms of glacial acetic acid, and afterward heating the solution until it becomes of a sirupy consistence, so as to form a jelly upon cooling. To use it, the jelly is placed upon a stove, in order to bring it to a liquid state, after which the edges of the broken crockery are coated with it, and the pieces strongly compressed. 3. A cement for fixing enamel plaques to nickel is prepared by dissolving together by a gentle heat:

Gum damar	10 parts.
Copal resin	10 "
Venice turpentine	11 "
Oxide of zinc	3 "
Ultramarine	quantities to tint the mass.

The coloring matter (zinc white and ultramarine) is stirred into the compound when the solids have been rendered fluid. This cement should be used hot, and when cold can be polished. It is also suitable as a putty for filling up cracks in enameled surfaces.—Pottery Gazette.

Glycerin Suppositories.—

Lanolin	30 grains.
Glycerin	30 "
Cacao butter	15 "
White wax	15 "

Melt the ingredients together, stirring well, and pour into chilled moulds. The suppositories should weigh 90 grains each.—Registered Pharmacist.

ENGINEERING NOTES.

Marseilles has just completed its drainage system, on the model of that of Paris, at a cost of 83,000,000 francs.

A bill legalizing the use of motor wagons on highways has passed its third reading in the British House of Lords.

The Zeitschrift fur Beleuchtungswesen gives the following comparison of the cost of heat per thousand calories by electricity, coal firing, and gas. Electricity, at Berlin price (1·92d. per B. T. unit); if all the heat is utilized, the cost per 1,000 calories is 2·42d. Coal firing at 20s. 3d. per ton, if 2 per cent. of the heat (at 8,000 calories per k. g.) is utilized, the cost per 1,000 calories is 1·5d. Gas at 33¾d. per thousand cubic feet, with a heating value of 153 calories per cubic foot; if half the heat be utilized, which can be done in modern apparatus, the cost per 1,000 calories is 0·444d.

The pitting or corrosion of steam boilers has suggested many remedial methods of treatment, and it is well known that certain substances—soda, potash, borax—added to the water diminish the dangerous property. Prof. Grace Calvert has shown that iron is not attacked by dry oxygen and carbonic acid, nor by moist carbonic acid, weakly by moist oxygen, but is rapidly oxidized by a mixture of moist oxygen and carbonic acid; and it seems that the greater the proportion of carbon in metal the better it can sistre this corrosion, wrought iron also corroding easier than cast iron. It is found, too, that where a feed heater is used, the corrosion of the latter is very small or non-existent, while the boiler is nearly always free from corrosion.

M. Charles Margot, of Geneva, has recently prepared some interesting aluminum alloys. Thus he finds that 72 parts of platinum and 28 of aluminum give an alloy having a golden yellow color, while other tints can be obtained by varying the proportions of the two constituents. The latter, however, are unstable, breaking up spontaneously. The yellow alloy, on the other hand, is stable, but is brittle. An aluminum alloy containing 75 per cent. to 80 per cent. of cobalt has a color ranging from straw to brown. It is extremely hard, and will scratch glass, but is very brittle, being easily powdered. Seventy-two per cent. of palladium gives with 28 per cent. of aluminum an alloy having a copper red color. It is hard and brittle, but stable. With 82 parts of nickel to 18 of aluminum a straw color alloy is produced, which is as hard as tempered steel, and can resist a hammer blow very well. Aluminum says it takes a fine polish, and has a fracture resembling that of bell metal.

There is now a tendency in many directions to speed up the machines in railway repair shops in order to increase the output of the works, and some phenomenal records have been made in this direction. This is being done in some cases in a perfectly straightforward way by putting larger pulleys on the countershaft or increasing speed between the countershaft and the tools. Others are making a great improvement by speeding up the quick return of all reciprocating machines. Some are combining these schemes until the shops have gained a semblance of life to which formerly they were strangers. It is related of a foreman who did not wish or dare to be frank with his men that a plan was recently arranged for the speeding up of the main shafts of his shops with the object of obtaining more rapid work in the hope that the men would not notice the change, but would work right along in ignorance of the increased output. This serves to illustrate a method of shop regulation for which foundation in fact exists to a greater or less extent in some shops. A good method successfully followed in several shops is for the foreman to set the pace for the men on each machine.—Engineering Review.

Some really original blasting tests have been made in several mines of Austria-Hungary according to a charging and firing method invented by the mining counselor, L. Jaroljmek, which tests, according to the Organ der Bohrtechniker, have furnished good results. While blasting was previously connected with the greatest dangers, as in firing the charge by means of fuses or electricity, external manipulations producing fire end sparks were required as impulse for the explosion of the charge. Jaroljmek locates the igniting impulse in the interior of the hole. The priming is based upon a chemical reaction, produced within the hole by water introduced into a body of caustic lime, which is arranged above the charge; the heat developed by the slacking of the lime is allowed to act from the outside upon a peculiarly constructed cap, which by its detonation explodes the charge within a certain time. By a very simple timing arrangement the operator is enabled to fix the time of the explosion. The body of lime is covered more or less by a sheet of tin foil. Thus the access of the water is limited to a larger or smaller surface of the lime body, whereby on account of the heat being developed quicker or slower, the charge is exploded correspondingly sooner or later.

A statement from the British Board of Trade, showing the production and consumption of coal and the number of persons employed in coal production in the principal countries of the world in each year from 1883 to 1894, so far as the particulars can be stated, has been issued as a parliamentary paper, says the Engineer. In 1894 the United Kingdom produced 188,277,000 tons, Germany 76,741,000, France 26,964,000, Belgium, 20,534,000, Austria 9,573,000, Japan (1893) 3,371,000, and the United States 152,448,000 tons. Of the British possessions, Canada produces between three and four million tons, and in addition imports about half her total consumption, principally from the United States. New South Wales produces about three and a half million tons, but, unlike Canada, her output has been of late years practically stationary. New Zealand yields over 500,000 tons per annum, but shows little or no increase. Natal's output rose from 26,000 tons in 1889 to 141,000 in 1894. Similiarly in British India the production has steadily risen from 1,316,000 tons in 1883 to 2,821,000 tons in 1894. The countries which import coal in excess of the amount they export are Russia, Sweden, France, Spain, Italy and Austria-Hungary; and of British possessions, Canada, Victoria, Queensland, Tasmania, New Zealand, the Cape, and British India, together with all the minor colonies, with the sole exception of Labuan-Borneo.

ELECTRICAL NOTES.

During the last two years the Telegraphic Department of the General Post Office, of England, have opened 700 additional telegraph offices in the country. It is proposed to send telegrams by cycle at the rate of 4d. per mile after the first three miles, instead of 1s. per mile.

The electric railway is only about ten years old in the United States, yet it is said there are 1,000 such roads in this country, using 12,000 miles of track, operating 25,000 cars, and involving an investment of about $750,000,000; moreover, this investment is increasing annually, at the rate of $100,000,000 for new roads and new equipment.

Insurance companies have decided that electric lighting, when the wiring is well done—and they have formulated special rules on the subject—is the safest of all illuminants. Statistics show the following comparative risks: Fires in one year from paraffin and kerosene, 259; from gas, 110; matches used for gas, 35; candles, 88; arc electric lights, 7; and incandescent electric lights, only 1.

Experiments are described by Otho Lehmann on the electric discharge through various gases, vacuum tubes, mixed gases with different forms of electrodes, and the discharge in a strong magnetic field. The paper is illustrated, says the Electric Review (English), by a number of figures of discharge phenomena, and the author considers the views of Goldstein and Hertz, viz., that the discharge takes place into the ether and not into the gas, to be erroneous.

M. Moissan has announced a new product, iron boride, from his experiments with the electric furnace. He has prepared a considerable quantity of it, and has examined its properties. He says that in the electric furnace a current of 300 amperes and 65 volts may be made to produce a large quantity of the compound within the space of five or six minutes, if fragments of iron be placed in a boron-brasqued crucible; but the temperature must not be excessive, as crystalline boride of carbon will also be formed.

In a combined irrigating and electrical plant recently constructed for a company in Mesa, Arizona, the water is taken from the Salt River and carried across the Utah canal to a pair of 21 inch turbines on a horizontal shaft, developing 400 horse power. One end of the shaft is connected by a friction clutch to a 200 horse power dynamo, which furnishes light and power for the town. The other end is connected to a pumping plant for irrigating purposes. "This novel station," says the Age of Steel, "is suggestive of great possibilities in this line."

In an English electric railway power house, where two gas engines of 130 horse power each are used in driving the generators, a very economical working is claimed, says the Engineering and Mining Journal. The engines are made by Messrs. Crossley, and use producer gas. The generators are belted to the flywheels, and the best result obtained has been an expenditure of 1·2 lb. of anthracite coal per horse power hour in ordinary service. The engines are run on an average 18 to 20 hours per day. A careful calculation has shown that the amount of fuel used is 4·5 lb. of anthracite per car mile.

In a paper recently read before the Institution of Naval Architects, at Berlin, on the design and construction of German men-of-war, Herr Dietrich stated that England would do well to copy Germany in respect to the employment of electricity on board warships, instead of so much steam. He stated that the German admiralty found that the only way to get rid of the heat from numerous steam pipes was to do away with them. By the use of electricity the conducting wire took the place of the steam pipe, and the ships were rendered more healthy as well as safer in action. All new German warships have electricity as the motive power for ventilating fans, turning gear on gun turrets, ammunition hoists, coaling winches, and such purposes.

Col. Bellon, of the French artillery, having observed that if a telephone is in sufficient proximity to, although not in actual contact with, a telegraph line, to be influenced by the current of the latter, certain sounds are produced in the telephone, whenever a message passes along the telegraph line. He has now succeeded by long continued experiments in drawing up a system showing the phonetic impression produced by each letter of the Morse alphabet, and thus enabling anyone, with some practice, to read, by the sounds of the telephone, any message circulating in a neighboring line. It will readily be understood that this discovery may be of great importance in war time, as in this way a telegraph line might be "tapped" without in any way interfering with the current circulating in it, and hence without the slightest indication to the stations connected by the line.—Die Vedette.

An electric lightship is being built in Portland, Ore., for the station at Umatilla Reef, says the Western Electrician. It is to be a composite structure of steel and wood, the framing being of steel and the casing of wood, copper bottomed. To prevent galvanic action in the hull, it is constructed as follows: First, an inner planking four inches thick is fastened to the steel hull by galvanized bolts and washers. These bolts are sunk into the four inch planking and plugged over. A layer of felt is then put on top of the four inch planking, and outside of this there is another layer of oak planking 1½ inches in thickness, this latter being fastened to the inside planking by composition nails. This oak planking is then sheathed with copper plates. The dimensions of the vessel are: Length, 112 feet; beam, 28⅛ feet; draught, 13 feet. It will be fitted with a propeller engine capable of giving a speed of nine miles per hour. This will be used in the case of storms to relieve the strain on the anchor chains by going ahead slowly, and also to propel the vessel in case a storm should ever make it necessary to raise the anchor and leave the station. The ship will have an electric light plant with all the machinery in duplicate for furnishing four 1,000 candle power arc lights at the top of each of the two masts at a height of 54 feet from the deck. There will also be provided a fog signal, consisting of a 12 inch whistle of the chime class, giving the first, third and fifth notes of the scale. The whistle will be blown either by steam or by compressed air.

MISCELLANEOUS NOTES.

For transport of liquid acetylene in Germany, the cylinders must be tested to 250 atmospheres, and must contain no more than one pound of liquid per three pints capacity; and they must have no copper, or brass or other alloy of copper about them. The solid carbide must be packed in iron, watertight.

The most curious use to which paper is to be put is that suggested by the recent patenting of a blotting paper towel. It is a new style of bath towel, consisting of a full suit of heavy blotting paper. A person upon stepping out of his morning tub has only to array himself in one of these suits, and in a second he will be dry.

The Paris Vie Scientifique describes a new camera invented by Moessard. It is pivoted upon a tripod, and is revolved by clockwork. As it revolves it unwinds a cartridge of sensitive film, passing it before the aperture of the camera in perfect time. Thus a continuous view of the horizon is taken on a single strip of film, the whole rotation consuming a piece 3 in. wide by 32 in. long. The camera may be stopped at any point in the revolution. The film cartridge contains sufficient for thirty complete panoramas.

Lighterage business about the harbor of New York, says the New York Sun, has been considerably damaged by a new labor-saving device in the building trade. It used to be that many lighters were employed in transporting from point to point the sand and lime that go to the making of mortar. A new concern, however, is now sending down scow loads of ready mixed mortar from Cow Bay. This mortar, of three qualities, is ladled out into iron carts and sent to all parts of the city where building operations are going on, and the lighters are less and less employed for carrying the materials that go to the making or mortar.

Toothpicks prepared by nature are a product of Spain and Mexico. Ammi Visnaga, an umbelliferous plant, is called the "toothpick bishop-weed" on account of the use made in Spain of the rays or stalks of the main umbel. These, after flowering, shrink and become so hard that they form convenient toothpicks. After they have fulfilled this purpose, they are chewed and are supposed to be of service in strengthening the gums. The spines of Echinocactus visnaga are in common use among the Mexicans for the same purpose. The number of these spines upon a single plant is something enormous. A comparatively small plant in Kew Gardens was estimated to have 17,000 and a large specimen in the same place could not have less than 51,000.

In a recent communication from the British Board of Agriculture a report is made of samples of imported butter analyzed under the direction of the Board from May, 1895, to February, 1896, inclusive. The total number of samples so analyzed was 995, representing the products of twelve different countries in whose products adulterated specimens were found were as follows: Belgium 5 samples, 1 adulterated; Denmark 182 samples, 8 adulterated; Germany 154 samples, 43 adulterated; Holland 250 samples, 66 adulterated; Norway and Sweden 109 samples, 2 adulterated; Russia 49 samples, 5 adulterated. The countries contributing samples among which no adulterated specimens were found were: Argentina 4 samples; Austria 57; Canada 39; France 62; New Zealand 21; United States 63.

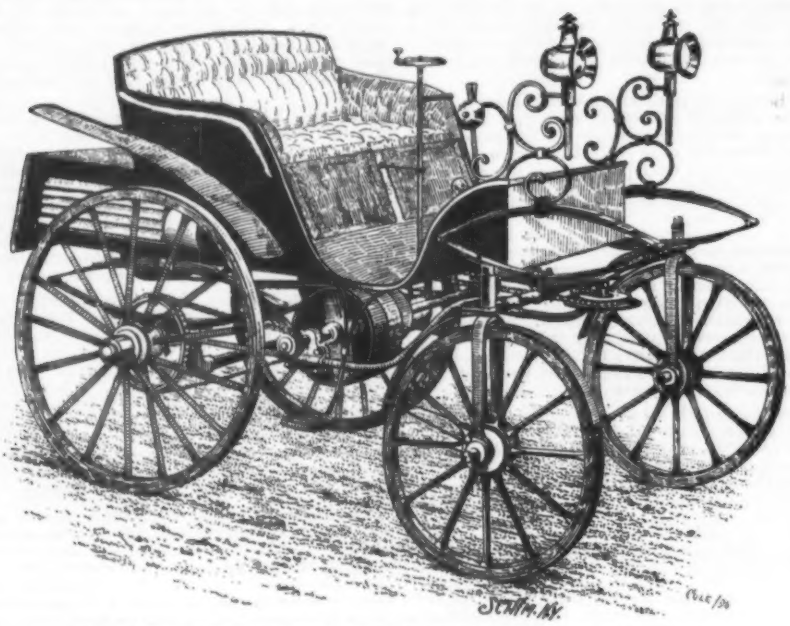
According to the Journal fur Gasbeleuchtung, M. Mare, of Paris, France, has constructed an incandescent or glow light burner, quite similar to the Fahnehjelm. It is intended for inside illumination mainly, and shows a construction on Fahnehjelm's lines. The glow body is made of threads of silk, or other suitable threads, which are soaked in a solution of one part of sulphate of magnesium, two parts of sulphate of erbium, two parts of zirconium and twenty-five parts of water. Nitrates may be employed instead of sulphates. The threads are first fastened to a platinum wire, then dipped into the solution and dried at a temperature of 60° C. After the threads are saturated and dried they may be coated with collodion varnish to fit them for transport. No data are given to show the durability or efficiency of these burners.

Switzerland manages to keep up an effective army of nearly 140,000 men at a very slight cost of money and time. The Swiss schoolboys are trained in gymnastics, in the manual of arms, and in the elements of company drill. The state encourages target shooting societies, of which there are 2,977, with a membership of 133,500, by a subvention of nearly $700,000 a year, the results being that almost every Swiss can handle a rifle. The soldiers serve ten years, between the ages of 22 and 32, being called out for drill on forty-five days in the first year and sixteen days in every subsequent year. Each man keeps his uniform, rifle and knapsack at home, and is responsible for their being kept in good order, a strict inspection being held in each district yearly. Consequently each soldier costs Switzerland $35 a year, instead of the $320 that is paid by England, the $225 by France and Germany, and the $110 by Russia. The Swiss Landwehr, the men between 32 and 44 years, first organized in 1876, numbers 80,000 men, and the Landsturm, the final reserve of all men capable of bearing arms, is reckoned at 270,000.

An innovation in the construction of floors is the use of a special preparation of paper pulp invented by Otto Kraner, of Chemnitz, Saxony. He calls the new material papyrolith. It comes in the shape of a dry powder which is mixed with water, dries in a short time and may be spread and planed down upon a foundation of either natural or artificial stone, cement or wood. The wearing quality of papyrolith is very remarkable, as are also its qualities of being solid and without a crevice, a bad conductor of heat and deadening all noise. A further advantage is the considerable amount of elasticity which it possesses and perfect safety from fire. Since the mass may be tinted with almost any color, it is possible to lay down several layers in different colors along side of each other, or to lay a floor with a mosaic design. Parquets with varied colored borders can also be laid down, and the same material may be used for wainscoting and stucco work, as also for panels and other decorative and architectural purposes. Mr. Kraner has also recently succeeded in producing a material similar to Lincrusta Walton at only one-tenth the cost of that expensive material.

PETROLEUM ROAD CARRIAGES.

At the Crystal Palace Exhibition, London, is now being exhibited a horseless carriage made by F. Lutzmann, of Dessau, which forms the subject of two accompanying illustrations. It is worked by a benzoline motor of the Benz type, with electrical ignition. According to the Engineer, to whom we are indebted for our illustrations and the accompanying particulars, the carriage

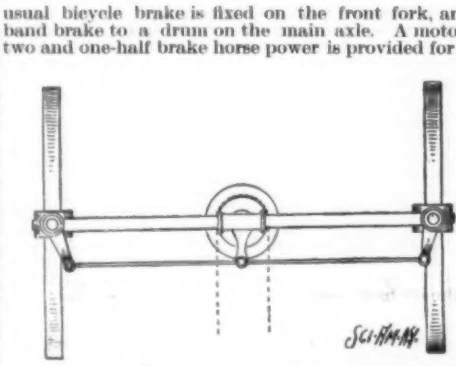


THE LUTZMANN THREE HORSE POWER MOTOR CARRIAGE.

runs very well and steadily on level roads and moderate hills, and will quite answer the purpose of many uses. The disposition of the engine, its connections by crossed belts to the second motion shaft, the water coolers on either side, the rectangular oil tanks, the cylindrical exhaust silencer, and the pipe connections, will be readily understood from the detail view. A plan of the steering axle is shown in another figure. The motor is of about three horse power, at about five hundred revolutions per minute, and the vehicle is intended to carry four persons.

We also illustrate, in perspective and section, the motor of a petroleum road carriage, made by Roots & Venables, and called the petrocar. The carriage consists of a steel frame carrying the oil motor, water tank for cooling the cylinder, and a coil of pipe for cooling the water. The whole is supported on three wheels with solid rubber tires. The main or rear axle is fitted with guides of inverted U shape, within which the sliding blocks, provided with springs, are fitted. The sliding blocks, of which there are four, carry the ball bearings. The axle is provided with a sleeve tube, which surrounds it, and to which the balance gear is fitted. A two-speed gear is also fitted to the axle to gear down the speed of the motor and change the speed for ascending inclines. The exhaust box is fixed on the back end of the frame.

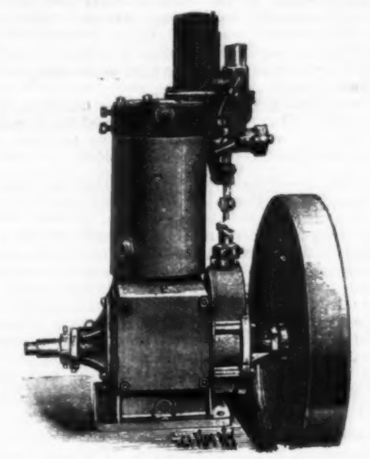
The power is transmitted from the motor to the axle by means of a chain and two chain wheels, the smaller of which is fitted loosely to the crank shaft, and is driven by a friction disk keyed on the crank shaft. The circulating water is carried from the large tank direct to the lower part of the jacket of the cylinder by means of a pump worked off the crank shaft, it then passes to the upper part of the jacket to a small tank through a cooling coil of pipe. The large tank is bolted to the main frame beneath the feet of the riders. The usual bicycle brake is fixed on the front fork, and a band brake to a drum on the main axle. A motor of two and one-half brake horse power is provided for the



THE LUTZMANN CARRIAGE—STEERING GEAR.

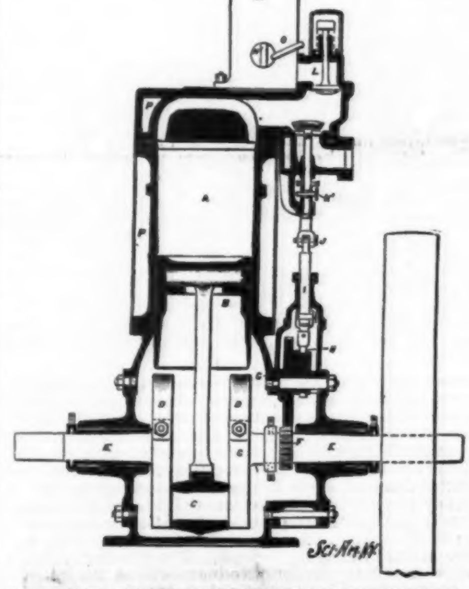
above carriage, which carries two persons; the total weight of the carriage is about 9 cwt. Russian and American petroleum oil is used of any specific gravity between 0·8 and 0·835, and the flash point from government test up to 130° F. The motor itself can be reversed, being started in the opposite direction. The gear is so constructed as to admit of this. The two-speed gear consists of toothed wheels and a clutch, all inclosed together in one casing.

The motor employed is shown herewith in perspective and in section. In the latter, A is cylinder, B piston, C crank, D balance weights, E taper on shaft to enable



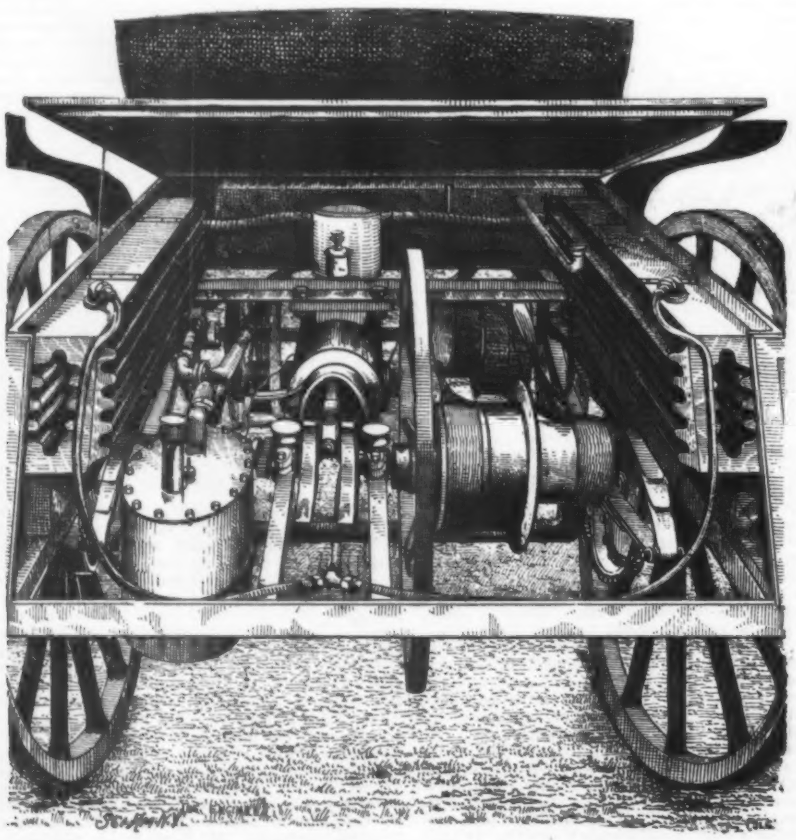
MOTOR OF ROOTS & VENABLES' CARRIAGE.

taper brasses to take up slack, F small toothed wheel, G toothed wheel, having twice the number of teeth of wheel F, H eccentric cast with wheel G, I reciprocating rod, carrying a Holt or rocking weight governor on the pin, J, for opening the exhaust valve, K. The pin, K, operates the lever, which reciprocates the usual oil feed spindle of the Roots oil engines. L is the admission valve, opening directly into the vaporizer. M is the casing containing the usual air heater and vaporizer, having at its center the ignition tube, N, of nickel alloy. The engine is started with the usual burner, which is then put out; and the heat is maintained by an automatic burner, a portion of which shows at O. A second groove is cut upon the usual oil feed spindle,



SECTION OF ROOTS & VENABLES' MOTOR.

the oil from which is swept off by an air blast, the air and oil being mixed and vaporized in the pipe, O, and directed upon the ignition tube, N. P is the water jacket.



THE LUTZMANN MOTOR CARRIAGE—ENGINE AND CONNECTIONS.

JAPANESE RAILROADS.

Mr. Gerard Lowther has drawn up an exhaustive report on the railroads of Japan, which has been recently forwarded to the prime minister by the British minister at Tokio. From this document Transport (London) draws a good many interesting facts, a few of which we print below. The total mileage of railroads is given as 2,118 and the population as 41,388,313.

At first some two hundred foreigners were employed on railway construction and management, but the Japanese government dispensed with their services as soon as possible. In 1882 only twenty-one of these remained, and in 1895 there were only six in the employ of the state. These latter are now only utilized for exceptional work and for purposes of consultation, and are no longer occupied with the management of the lines, which rests entirely in Japanese hands.

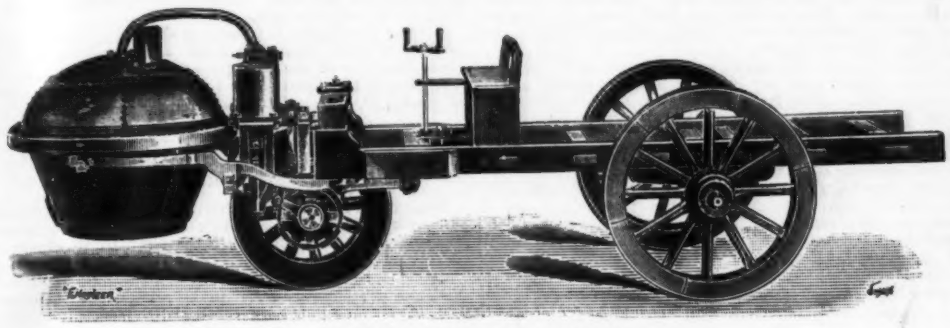
For the capital required for the construction of the lines Japan also depends upon herself, foreign capital being excluded, except in the case of the first railway, in which recourse was had to foreign markets. The total amount of railway mileage open to the public twelve months ago was: government lines 580 miles and private lines 1,538 miles, making a total of 2,118.

A feature of the Japanese railway system, which is worthy of note, is the fact that in the main island the railways were built by English engineers, and that English locomotives and rolling stock were brought into use, to be followed, however, later by a few American and German locomotives. In the northern island the

first 50 miles of railway were built by Americans, and the rolling stock, etc., is American; but English methods were followed in subsequent extension, and in Kiushiu the lines were built by Germans, and German rolling stock employed. An engine has been built at Kobe, but by an English engineer, Mr. R. F. Trevithick, M. Inst. C. E., and more are in process of construction under his supervision, the material being imported from Great Britain. This locomotive was finished in May, 1893, in the government shops in Kobe, and has proved to be an unqualified success, and during the first two years ran 57,473 miles. In price it compared very favorably with those imported, its total cost amounting to $8,992, or, at the then rate of exchange of 3s. to the dollar, £1,349.

In April, 1894, there were 140 locomotives on the government lines, while the private lines owned 142. The cost of American locomotives was 10 per cent. higher than those purchased in Great Britain, and their consumption of coal 14 per cent. higher. As far as locomotives are concerned, Japan stands in much the same position as India, but with respect to vehicles for the carriage of merchandise Japan holds the lowest place. This is accounted for by the fact that the country consists of islands, that the principal railway runs along the coast, and that there are three ports at which nearly all the principal lines of steamers touch, thus rendering it impossible for the railway to compete with the steamship carrying trade between the ports. The result is that the proportion of earnings from goods traffic is very small, being only 20 per cent. as against 52·8 per cent. in the United Kingdom, 66 per cent. in the United States, 72·3 per cent. in Germany, and 77 per cent. in Austria-Hungary.

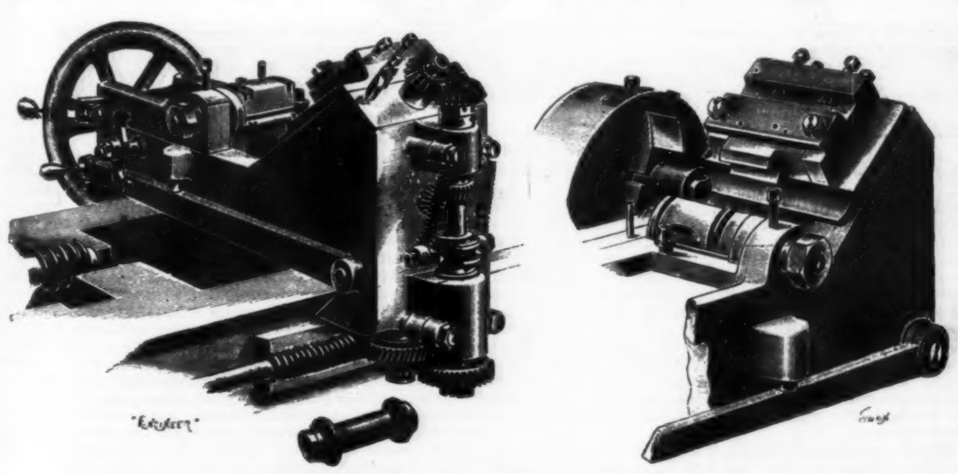
The first and second class passengers form a very small proportion of the traveling public—certainly not more 6 per cent. of the whole. A comparison of the third-class fares with those in operation in this country and Germany shows that whereas in England the fare is about 8s. per 100 miles, and it Germany about 7s., in Japan it is only 2s. In other words, third-class traveling costs in Japan just a quarter of what it does in England. The total number of passengers carried on the railways of Japan in the year 1894–95 was 36,641,113, that is to say, 14,883,986 on the government lines and 21,757,127 on the private lines.



CUGNOT'S STEAM CARRIAGE.

BICYCLE HUB FORMING LATHE.

This is a very substantial tool, having the headstock cast solid with bed, the spindle being driven by a two-step cone for five inch belts and has friction back gear which is so proportioned that the cone gives the correct boring speed, while by throwing in the back gear the speed is right for forming. The spindle has a two inch hole and can be supplied with a stockfeeding mechanism if desired. The turret is of solid design gibbed directly to bed and is fed by a screw under the turret, as near the line of strain as possible. Two changes of power feed are provided. The hand motion is operated by a pilot wheel having long handles.



BICYCLE HUB FORMING LATHE.

The hub-forming slide, of which we show details, is an interesting feature, and is made in box form gibbed to the bed so as to be rigidly held in position. But one forming cutter is used, of the round type, as can be seen in the illustration, this being easy to set and held in exact alignment with the spindle.

The back slide moves in dovetailed ways at an angle of forty-five degrees from the plane of the cutter slides, the two slides being geared together so as to feed exactly together as the stock is removed, thus supporting the hub with the greatest nicety against the action of the cutter. The back jaws are made of high grade tool steel, hardened, ground true and polished. They are held in the slide by a steel clamp and bolts, and both upper and lower jars are independently adjustable by means of set screws. A pump is furnished with each machine, which is driven at constant speed by separate pulleys on the countershaft. This supplies an abundance of oil to a manifold oiling device—not shown in cuts—and which is so arranged as to oil both the cutter and the back jaws independently. Power feed for the cutter and back slide is furnished, operated by worm and gearing from the rear feed shaft, which also feeds the turret. An automatic stop mechanism is also provided, which stops the feed at any predetermined point.

This method of forming produces very smooth work, as it holds the stock very steadily against all tendency to spring away from the cut, and at the same time is rapid in action, because the hubs can also be bored while the forming cutter is at work, and then, when the forming operation is completed, the lathe may be run at the cone speed to finish the drilling. A cutting-off tool with adjustable blade is pivoted on the cutter slide, which cuts down the stock after the forming, so that the drill itself removes the hub from the bar.

They are made by the Niles Tool Works, Hamilton, Ohio.—Machinery.

CUGNOT'S STEAM CARRIAGE.

Many of our readers will be interested in the engraving we now publish of Cugnot's steam propelled vehicle. Cugnot's old engine, made in 1771, was the first selfmoving land carriage ever made, as far as we know. The engraving we publish is from a photograph by Mr. F. A. Field, and was published in the Engineer. Mr. Field says: "Being greatly interested in all that concerns locomotive work, I have read with pleasure many numbers of your paper dealing with the historical side of the development of the locomotive, and often wondered why Cugnot's engine should not have had a more conspicuous place therein, but presume that not being a railway machine it might hardly be held to count for much in the history of our railway system. Anyway, an illustration of this venerable auto-car should have found its way to your pages, but I do not believe it has as yet been photographed. Some time ago, being desirous of adding the picture of this engine to my collection, I applied to the curator of the Conservatoire des Arts et Metiers, Paris, for the necessary permission. No particular objection was raised to the idea of photographing the engine, but apparently it was found impracticable to have it done, as it is stowed away in a rather hole-and-corner fashion in the museum, and much in the dark. I should think, however, if influence could be brought to bear, the obstacles might be overcome, and a very good and interesting photograph obtained. Close by the original, however, is an excellent model, and this was photographed for me, and I send you a copy thereof, trusting it may be of some interest to you. Barring a certain 'newness' of look and excellence of finish, it is an exact copy of the engine itself."

TRACTION SYSTEMS OF CONTINENTAL EUROPE.

The question of rapid transit having, for some years back, been exercising the minds of the authorities of most of the cities of Continental Europe, one would expect in surveying this field, judging, of course, by what has been accomplished in this line in the United States, to find that all the large and many of the smaller cities had introduced one or more of the representative traction systems already adopted by the more progressive cities of other lands. But such is not the case. In Paris, it is true, the older modes of travel have been practically superseded by new methods of traction; but, on the other hand, Berlin still clings to its antiquated systems. Indeed, only lately did the city wake up enough to appoint a commission to visit Dresden, Dessau, Hagen, Frankfort-on-Main, Strasburg, Paris, London, Liverpool, Glasgow, Edinburgh, Rotterdam, The Hague, Amsterdam, and Brussels, to examine and report upon the traction systems in each of these places "with respect to cleanliness, speed, economy, and convenience as compared with the horse tramways of Berlin," in order to investigate the subject in detail with a view to the ultimate adoption of one of the improved systems. Other representative cities of Continental Europe lie naturally between these extremes; but, if the truth is confessed, they resemble Berlin more than they do Paris with regard to the progress made in abandoning old and introducing new and improved methods of surface traction. This is the more surprising when it is considered that in the United States a rapid transit system has been adopted by almost every town that can boast a population of ten thousand.

What strikes the traveler abroad is the fact of the multiplicity of systems adopted. There is practically no one type that has been settled upon as superior to all others, even in a given application, the competing systems dividing the field between them. In this country the trolley system has become the standard for interurban traffic and for cities which do not object to the disfigurement of their streets. The only other systems competing with the trolley in this country are the cable, the underground electric, and the storage battery system. The cable is gradually being superseded by other systems which admit of very much cheaper road construction, so that, at most, there are but three systems here that are disputing with one another the supremacy of the field of electric traction.

But in Continental Europe we have a different state of affairs. In addition to underground electric, trolley and storage battery systems, there are in use at present, as at Dessau, the Luhrig gas motor system, and, as at Paris, the Mekarski compressed air system, the cable system, the Serpollet system, and the underground steam railway, or eight different systems in all, not including the horse cars. Strangely enough, Paris has six of these eight systems in successful operation at the present time, viz.:

(1.) The accumulator system (Laurent-Cly) on the three lines known as the (1) St. Denis-Madeleine, (2) St. Denis-Opera, (3) St. Denis-Neuilly.

(2.) The Mekarski compressed air system on the line between Ligne de St. Augustin and Cour de Vincennes.

(3.) The cable system (similar to that in Edinburgh) on the line between the Place de la Republique and Church at Belleville.

(4.) The Lamm & Francq system sans foyer (an improvement of the Rowan system) on the line between the Place de l'Etoile, Courbevoie and St. Germain.

(5.) The Serpollet system on the lines between the Madeleine, Asnieres and Neuilly and St. Denis.

(6.) The underground steam railway to Sceaux.

Of the electrical systems employed abroad, Americans are very familiar with the overhead wire system, which is practically identical with our own, save that instead of a trolley wheel a sliding wire contact is employed for drawing off the current from the overhead conductor.

The first underground electric system used abroad was established at Budapest, which has since become the mecca of the faithful among electric traction engineers. Inasmuch as the Budapest system differs from those laid down in Washington, D. C., and in New York City, a short description thereof will not be out of place in this connection. This system, as is well known, was introduced by Siemens & Halski in the capital of Hungary. The conduit, placed under one rail, is about eleven inches wide and thirteen inches high, the slot of which "consists of two beam rails having no inside lower flange, and fastened to the conduit frames by wrought angle iron pieces." The conductors, positive and negative, are made of angle iron, and are fastened by means of insulators to the conduit casting sufficiently high above bottom of conduit to be protected from any water that may collect in the conduit. As both conductors are insulated there is no need of an earth return. If any water collects in the conduit it runs to the lowest points and passes therefrom through settling boxes to the sewers.

The city of Dresden has recently concluded contracts with the "Dresdner Strassenbahn-Aktiengesellschaft" and the "Deutsche Strassenbahn-Gesellschaft" (two companies operating their lines by electricity, and now paying the city a certain percentage of the gross receipts for the use of the streets), whereby it will acquire, in about twenty-five years, the whole of the above lines, which are of the open conduit type, known as the "Klette" system. This installation, also made by Siemens & Halski, embodies certain advantages over the conduit system at Budapest just described. These advantages are, according to Lightning:

(1.) The out-going conductor rail only is laid in the conduit, the return circuit being formed by one of the ordinary track rails.

(2.) The conduit is made more easily accessible for the purpose of inspection or repair by means of removable plates.

(3.) The change onto an overhead line, at locations where much surface water is liable to accumulate so as to render the conduit impracticable, is simpler, and, at the same time, automatic.

(4.) The cost of installation is considerably less.

(5.) The interruption in the contact at rail crossings is readily overcome by the inertia of the car.

(6) The work of "conversion" presents no difficulties and necessitates no suspension of the traffic. In Dresden the cars make about six miles and outside about ten miles an hour.

Storage battery cars have recently come into very decided prominence in Continental cities, and it looks now as if they might become very formidable competitors of all the other systems.

In Paris storage battery cars have been in operation something over three years, during which time they have made between two and three million car miles. At the present time there are, on the Madeleine and St. Denis road, some thirty twenty-two foot cars, double decked and capable of seating between fifty and sixty persons. The competition of the steam motors, the gas motors and the compressed air motors has been very severe in the French capital; nevertheless, it appears that the Tramway Company will replace their horse

cars with storage battery cars on their other lines as soon as it is decided to make the conversion. Some experiments, in what is known as "recuperation," have recently been made on the above lines by which it has been demonstrated that a car while descending a ten per cent. grade may recover fifty-seven per cent. of the energy expended in ascending it, forty-two per cent. may be recovered on a four per cent. grade and twenty-three per cent. on a two per cent. grade. With a coefficient of traction of twenty-two pounds per ton the recuperation becomes zero on a one per cent. grade. If the coefficient of traction were eleven pounds per ton, sixty-three per cent. of the energy expended in ascending a ten per cent. grade could be recovered, as could twenty-three per cent. on a one per cent. grade. This is of interest as indicating how part of the energy that is now lost in the ordinary trolley cars may be recovered.

The most recent practice in constructing battery cars is to place the battery under the car, thus eliminating the disagreeable features arising from locating the battery under the seats, as was formerly done. In the newer cars the battery weighs but three thousand pounds, and can make from eleven to twenty-two miles per charge. No handbrakes are used in stopping the cars, this being done by charging the battery.

The same storage battery company which equipped the Paris tramway lines has also equipped a road at Nice, and have recently contracted to build roads at Marseilles and Avignon.

Outside of France, the storage battery system is making equal headway. The experiments with this system at Hagen, Westphalia, carried on by Messrs. Muller & Einbeck, are said to be both technical and commercially successful. It is to be remembered that the above-mentioned firm undertook the equipment and maintenance of the charging station, the cars with their motors, the batteries and all accessories, for a certain price per car mile, the tramway company bearing only the general working expenses, and demonstrated that this could be done as cheap, if not cheaper, than with other electric systems.

In addition to the above storage battery lines, it may be mentioned that accumulator lines are being operated in Hanover and Vienna. At The Hague the Hague Tramway Company is experimenting with storage batteries, while the same system is certain to be adopted along the Vosnessersky Prospekt, the Erbsenstrasse and the Kasanekaya, in St. Petersburg, as soon as the experiments, now being made there, are completed.

What is believed to be the first application of polyphase currents to electric traction is now being made at Lugano, Switzerland, where an electric railway is equipped with a polyphase plant, and will shortly be ready for operation.

The power plant for this line is situated seven and one-half miles from Lugano, consisting of a three hundred horse power turbine, driving two one hundred and fifty horse power three-phase alternators. The generators are of a special type, in which the field coils and the armatures are stationary and the iron "star-shaped" pole cores constitute the only moving parts. The current generated has a potential of five thousand volts. At Lugano this current is transformed down to four hundred volts, at which potential it is distributed to the cars by two overhead wires, the third conductor being supplied by the rails.

The cars are equipped with three-phase motors, which receive current through a "double trolley wheel apparatus." These motors give a speed of about nine and one-half miles an hour, which, however, can be varied by means of a special form of controller.

The advantages arising from the use of polyphase currents on electric railways are:

(1.) The possibility of utilizing cheap power derived from a distant source.

(2.) The motors require no commutator, collector nor bare electrical conductor upon them.

The disadvantages of the system are that a double trolley line is necessary, while the trolley collector wheels must be duplicated.

Although the details have not reached us, we understand that Professor Mengarine has invented and patented a method for utilizing the alternating currents generated at Tivoli, Italy, for the purpose of electric traction, and that cars are now operating on this system in Rome.

The overhead system, used in conjunction with "direct" currents, is employed, to a considerable extent, in Continental Europe. The cable system also finds occasional application. Inasmuch, however, as we are very familiar here with these systems, they do not require any elucidation at our hands. The same may be said of the Mekarski compressed air system. With regard to the Lamm & Francq method, in use on the line between the Place de l'Etoile, Courbevoie and St. Germain, we have not been able to get the details.

Quite different from any of the systems described is the gas motor car system recently applied at Dessau, in Germany. This system was introduced in November, 1894, on two sections of track, aggregating two and one half miles in length.

There are nine cars operated in Dessau on the Luhrig system. These cars, ready for running, weigh about six tons each. They have carrying capacity for twenty-eight persons, fifteen seated and thirteen standing. The cars were constructed at the Van der Zypen & Charlier works, of Cologne; the motors at the Dentz works, also in Cologne.

In external appearance the cars resemble the ordinary street horse car. By means of doors on the sides of each car, opening outward, the motors are exposed to inspection. According to La Genie Civil, the motor is of the horizontal type of Otto gas engine, with two cylinders in tandem, situated under one of the rows of seats of the car. These motors have an output of seven effective horse power, which may be increased to eight effective horse power if necessary. The gearing of the motor to the axles is such that a speed of seven to nine miles an hour can be maintained. It is said that these motor cars are capable of hauling a trailer full of passengers, and even of ascending grades with same. Both freight and passenger cars are operated by the Dessau Tramway Company. Each car carries three gas receivers, one of which is placed under the row of seats opposite to that under which the gas motor is placed; the other two are located under the platforms. Their volume is twenty-eight cubic feet, which suffices for a round trip. The charging of these receivers may be effected in two minutes; the renewal of the water, used for cooling the water jackets, requires from three to four minutes.

The population of Dessau is forty-two thousand five hundred. Since the line was first inaugurated its length has been increased and four new cars have been ordered, which indicates that the tramway company is satisfied with the system. The Berlin commission, already referred to, examined the Luhrig gas motor system at Dessau, but was not favorably impressed by it.

In speaking of the Paris lines between Madeleine, Asnieres and Neuilly and St. Germain, mention was made of the "Serpollet" system. Properly speaking, this belongs to the genus steam tramway; and yet, as it possesses several characteristic features which distinguish it from other steam tramway systems, it deserves special mention. In order to keep down the proportions of the engine, steam is employed at abnormally high pressure. Steam is generated by introducing water, by means of a jet, into an arrangement of steel tubes of very great strength, heated externally. This water is immediately converted into superheated steam, which works direct on the piston of the engine. While the ordinary steam engine works at about one hundred and twenty pounds pressure, the Serpollet engine works at three hundred pounds. To provide against the possibility of explosion all the parts of the evaporator and engine cylinder are made extra strong. The engine, which possesses two cylinders, is located between the two axles, to which the motion of the piston is transmitted by a chain and sprocket wheel arrangement, the reduction being four to one. The boiler is provided with water by means of a pump, which works automatically. In order not to trouble the engine driver by requiring him to oil the engine during the trip, lubrication is made automatic.

The steam cars of the Serpollet automobile system are double-decked, resembling somewhat the battery cars on the Madeleine-St. Denis lines, although there is no feature on the latter that resembles the high, square chimney of the Serpollet cars, in which the boiler tubes are placed. These cars have capacity for about fifty persons. Inasmuch as coke is used for fuel, and the disagreeable odor of the burning gases reduced to a minimum by being carried high above the car by the strong draught produced in the chimneys, the travelers do not experience any inconvenience from the escaping gases or from the heat. In winter the exhaust steam is utilized to heat the cars.

All the machinery is placed in sheet iron cases, which protect it from dust and mud, and incidentally suppress the odor of the hot grease. (For a complete description of this system see La Revue Technique, Paris, of March 25, 1895.)—The Car.

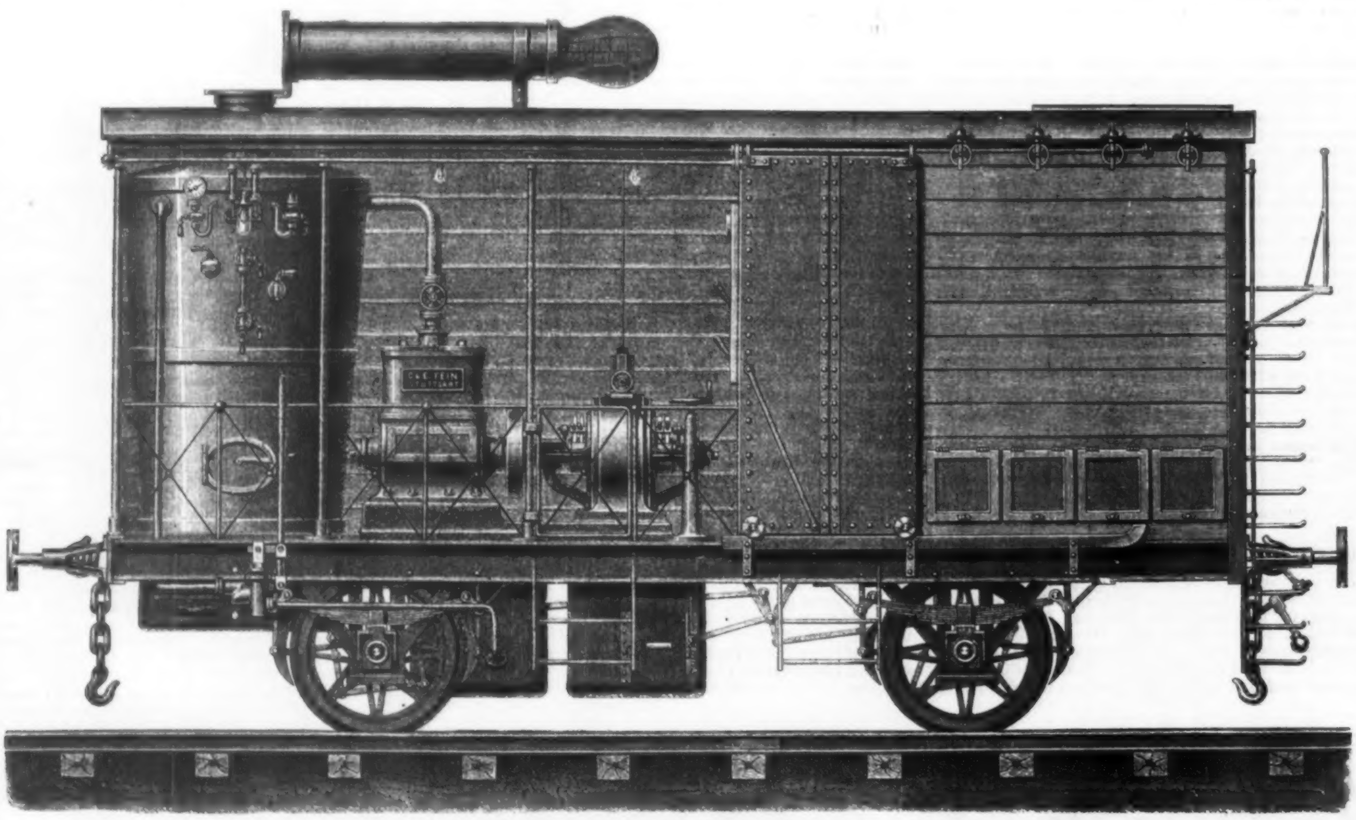
TRANSPORTABLE INSTALLATION OF ELECTRIC LIGHTING.

Electricity certainly produces the best light in public workyards, and in centers of crowded population. There is no other source of light that, in its effects, so closely approaches the light of the sun. Besides, it permits of a normal distribution of the light produced. Although it is possible to install machines for the production of electric energy permanently in workyards, open for a long period of time, it is perhaps in cases in which a lighting bordering upon perfection would be the most desirable one that it is impossible to employ electricity. Such is the case in the work of excavation and repair following accidents, especially upon railways. After a derailment or a collision it is necessary to work without relaxation, and, as a usual thing, there is no good artificial light at one's disposal. It is also often the case that in the event of serious accidents in certain enterprises, such as mining, the machines that produce light are affected like the rest, and can no longer render any service. From a military standpoint, in times of mobilization or even simply of maneuvers, certain stations might have need of being temporarily lighted in a very complete manner, although the ordinary necessities would in nowise justify the permanent installation of machines designed to produce such lighting.

The establishment of C. & E. Fein, of Stuttgart, has attempted to create the equipment necessary for the quick transportation, and the installation at any place, within a limited space of time, of an electric light plant. It has established two types of transportable installations of electric lighting, which, as we shall see, are applicable to somewhat different cases.

The first type is designed for carrying upon a railway, and in order to be utilized thereon, an electric light plant comprising a boiler, motor, dynamo and arc lamps and their supports, the whole arranged in a special car that may be coupled to any train whatever.

The "Central Works," so to speak, are found all ready for operation in the car. It only remains to plant the poles designed to carry the arc lamps, and to establish the cables in order to set the whole in operation. This is an excellent solution of the question, if it is possible to leave upon the track a car that prevents access to it (as in the case of accidents, where the encumbering of a track already inutilizable is of little consequence), or if it is possible to shunt such car upon a side track (as is the case in military operations when it is a question of lighting a determinate operation in a



TRANSPORTABLE INSTALLATION OF ELECTRIC LIGHTING.

station inadequately provided with lamps in ordinary times).

But it may be easily seen how much this solution leaves to be desired when the lighting is to be done somewhere else than upon the track of a railroad. Such is the case with work to be done upon a bridge or at the approaches of a besieged city. There is then substituted for the car, designed for running upon rails only, two light vehicles capable of rolling over ordinary roads. These vehicles are placed upon railway trucks and thus carried as near as possible to the place where they are to be used. One of the two vehicles constitutes the works, with motor and dynamo. The other carries the measuring apparatus and switch board, as well as the cables, lamps and poles. The details of installation of the vehicles that we have just mentioned may be varied within wide limits, and the motors used may be steam, gasoline or compressed gas engines.

Our engraving represents a car arranged as a rolling central station of electricity. The boiler adopted here is of the vertical type. Of course, preference may be given to a horizontal type if there is any advantage to be derived from it. It will be seen that, during the running of the car, the smoke stack is turned back upon the roof. The motor is a Westinghouse one. This kind of engine is so well known as to need no description. Let us remark simply that this type of motor appears to be well adapted for the purpose. It is, in fact, very strong, its mechanism is protected against external influences, and it runs with perfect regularity. For current use, however, it has one serious drawback, and that is it consumes an enormous amount of steam. Now, when it is a question of an exceptional work of urgent character and short duration, the question of expense is accessory, and in this case we may be certain that the Westinghouse engine will give good results. It has, besides, the advantage of permitting of a direct coupling with the dynamo. It will be seen that about half of the car is occupied by the works; the rest serves for storage.

Now that gasoline motors have entered the domain of practice, it would perhaps be preferable to substitute one of them for the steam engine. The latter, in fact, always requires an appreciable amount of time for being put under pressure (and this is not always without inconvenience), while the gasoline motor is set in operation almost instantaneously. The Messrs. Fein have been well aware of the interest presented by the use of the gasoline motor, and have devised types of mobile vehicles having single cylinder motors of as high a power as 3,500 watts, and double cylinder ones for higher power. They are now constructing four models of this type, the power of which ranges from 2,400 to 6,500 watts. It is a question here of vehicles designed for running upon roads and not of railway cars. The frame is carried by two axles. At the back of the vehicle is the motor, one of the fly wheels of which transmits motion, through a belt, to the dynamo situated in front. A light roof covers the whole.

The models with steam engines present two varieties, according as the boiler is vertical or horizontal. In the first case, the relative arrangement of the motor and dynamo is either the same as in the gasoline motor vehicles (a small single cylinder motor behind, the *dynamo in front*, the transmission by belt and the generator in the center of the vehicle), or else one adopts the Westinghouse engine, which is coupled directly with the dynamo. The boiler is then placed in the rear of the vehicle, the coupled engine and dynamo being in front.

When the boiler is horizontal, the aspect of the vehicle changes completely. It assumes the form of a road locomotive having a bracket in front of the smoke stack for supporting the dynamo. The engine is mounted upon the boiler, the axes of both being parallel) and the transmission is effected through a belt. The smallest apparatus have a power of 2,400 watts, and the largest a power of 13,500. These latter admit of 20 horse power motors. Their boilers withstand pressures of 7 atmospheres. The engine makes 120 revolutions and the dynamo 700. The vehicle in running order weighs about 24,500 pounds.

Let us note, by the way, the advantage in weight gained by the use of gasoline motors of equal power. The steam vehicle of 2,400 watts weighs 6,380 pounds, and the gasoline one but 4,180. For 6,500 watts, the weights are for the steam one 16,280 pounds, and for the gasoline one 7,920.

With the electric vehicle runs necessarily the storage one whose supply of lamps, reflectors, and cables is proportionate to the power of the dynamo.

The only model of electric vehicle that is now constructed is made for 4,500 watts. It suffices to supply eight 10 ampere arc lamps or a single source of 60 amperes. The engine is a Westinghouse one of 7½ horse power, making 450 revolutions a minute. The compound dynamo makes, naturally, the same number of revolutions It is capable of giving, if need be, a tension of 65 or 120 volts. The vehicle carries a switch board, the lamps, the cables and the necessary accessories. The total weight is 15 tons. The proportions of the electric works running upon rails might easily be increased. Were there need of it, a storage car might be added to the electric light one, as in the case of the ordinary road vehicles.

It would seem as if such installations might render valuable services in the exploitation of railways, in extensive public works, and especially in the military art.—La Revue Technique.

MANUFACTURE OF CONDENSED MILK IN SWITZERLAND.

SWITZERLAND, says La Nature, to which we are indebted for the accompanying engraving and article, stands at the head of the condensed milk industry. The milk manufactured in this country is unsurpassed. Although other countries may produce milk which produces better butter, as for example Normandy and Holland, none of them can rival Switzerland in the delicious flavor, the delicate aroma and excellence of quality of condensed milk. This is due, no doubt, to the richness of the flora of that country.

The milk industry, which during the past few years has developed abnormally in Switzerland, is conducted principally by three companies or firms—the Anglo-Swiss Company, with factories at Cham and Guin; the Lapp Factory at Epagny; the Henri Nestle Company, with factories at Vevey, Bercher and Payerne.

The milk export (and here the amount of export is equal to the amount manufactured, as the home consumption is very slight) has increased, according to the figures of the federal bureau of customs, in 1887 to 111,312 metric quintals, or 494,720 cases of 48 boxes each, in 1888 to 117,700 metric quintals, or 520,000 cases, which represent the milk of 15,000 cows and of 250 villages. In 1888 the export of Swiss cheese amounted to 238,390 metric quintals, which represented a value of 30,450,000 francs. We mention these figures to let every one comprehend the importance of this new industry, whose exports are already one-half as great as the much older industry of cheese making.

Condensed milk is manufactured as follows: The milk, as soon as drawn, is taken by the farmers to the dairies, which are established in each village or group of villages. The dairies are run by a syndicate with which the manufacturers deal, and establish the fixed prices. Here the milk is cooled. On reaching the factory the milk is warmed for the first time in a water bath, and a second time in copper vessels, where the temperature reaches 80° C. It is then sweetened by adding the best quality of sugar in the proportion of 13 to 100 in weight, the sugar being forced into vacuum pans by means of a pump. These vacuum pans are for condensing the milk, and are similar to those for condensing the juice of the beet root, having a double bottom and spiral pans in which the steam circulates. The water contained in the milk is removed in the form of vapor by means of a jet which is connected with the top of the vacuum pan and which is operated by means of a pneumatic pump. When the milk has been sufficiently condensed it is removed from the vacuum pans and cooled in vessels placed in reservoirs of running cold water. It is only necessary now to pack the milk into tin boxes cylindrical in shape, and hermetically sealed, the box and contents weighing one English pound, and being in condition for shipment to any part of the world.

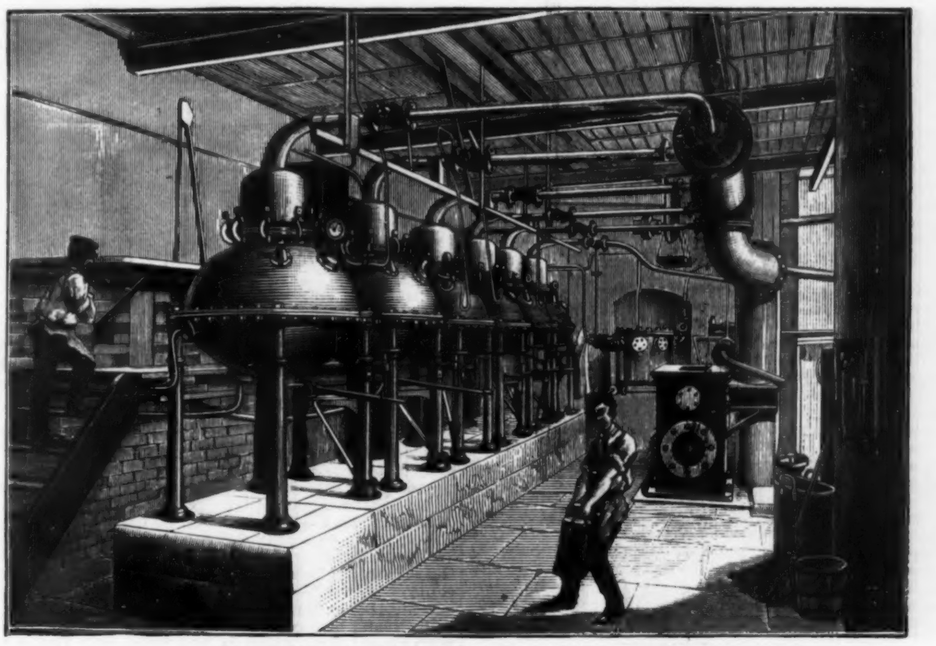
In the preparation of the condensed milk it may be observed that the milk, as taken directly from the cow, has on the one hand simply been deprived of the water it contained, while on the other hand the only addition consisted of pure sugar, which is designed to preserve the milk better. It contains all the elements of the fresh milk, which has practically undergone no modification, the boiling of the milk under slight pressure having never passed 80° C. It can be affirmed, therefore, that the condensed milk possesses all the nutritive qualities of fresh milk. The following analyses, one by Prof. Soxlet, of the University of Vienna, and the other by Mr. Otto Hehner, the distinguished chemist of St. Thomas' Hospital, London, show the chemical composition of the Swiss milks:

	Milk Nestle.			Milk of the Anglo-Suisse Company.		
	Dr. Hehner.	Dr. Hehner.	Soxlet.	Dr. Hehner.	Dr. Hehner.	Soxlet.
Water	23·59	25·04	25·28	24·21	26 44	24·70
Fatty matter	11·58	11·12	8·62	9·95	10·52	6·02
Caseine	9·60	8·18	10·25	8·72	8·22	9·77
Sugar	53·21	53·78	53·82	55·18	52·86	57·40
Salt	2·02	1·88	2·03	1·94	1 96	2·11
	100·00	100·00	100·00	100·00	100·00	100·00

These analyses are confirmed by analyses by Dr. Brunner, Professor of Chemistry at the University of Lausanne, and Dr. Christen, of Paris.

The problem of preserving milk is solved. The milk may be preserved for several months, and the flavor is very agreeable. We do not need to mention the various uses to which it may be put, nor how extensively it is used in all extensive communities, on board ship, in our colonies, and in all countries where fresh milk cannot be obtained.

NOTE.—It should be borne in mind that the manufacture of condensed milk was first introduced in America, and was the result of American invention. Mr. Gail Borden, the original inventor of the process of condensing milk in vacuo, procured his basic patent in 1856. An enormous industry has been founded upon his patents, and although we do not question that Switzerland may excel in this manufacture in Europe, we believe that the United States, both in respect to volume of manufacture and excellence of quality, distances all competitors.—ED.



THE SWISS METHOD OF CONDENSING MILK.

HOW RUBBER STAMPS ARE MADE.

RUBBER stamps do not make as much noise as typewriters, nor do they demand as much attention as telephones, but to the average business man they are fully as important. Less than a score of years ago a rubber stamp was regarded as a lazy man's friend. To-day it is the busy man's faithful ally—the banker's third hand—and a necessity in every office. The manufacture of rubber stamps has risen to a prominent industry, and it is a trade which, thus far, has successfully resisted the tendency of the times to centralize and consolidate into large establishments. In that respect it resembles job printing business, and the little shops in which rubber stamps are made are scattered all over the business centers of cities. The rubber stamp man must keep close to the heart of commerce. His sign must swing where the passing merchant can see it plainly, for when a man wants a rubber stamp he wants it at once and wants it "bad."

On a rush order a rubber stamp can be turned out ready for work an hour after receipt of the "copy." Generally, however, the stamps are made in batches, so that a number of them can be forwarded and finished at the same time. The machinery and appliances used in making them are simple compared to those required in many lines of trade, and consist of a combination of a job printing office and a rubber works.

The major part of the time used in the process of making the article is taken up in the preparatory work, for but six minutes are required to produce the rubber stamp proper.

In the first place, the type, plain, ordinary type, such as is used in any printing office, must be "set up" according to the "copy" furnished by the man who orders the stamp. The typesetter composes the matter, arranging the type and design so that a proof taken with printer's ink is exactly like the impression that will be made by the finished stamp.

He groups a number of orders in one form so that a dozen or more can be executed at the same time. This form is a steel or iron frame provided with wedges and set-screws which lock the type firmly in place. The form is about eight inches wide and ten inches long.

When the compositor has completed his work he turns the form over to the workman who makes the mould in which the rubber stamp is cast, or, rather, "pressed." The mould is made of a composition of plaster of Paris and French chalk, mixed up with a solution of dextrine, gum arabic and water, and some coloring matter which gives a reddish-brown tint to the composition.

A large boxful of mixed plaster and chalk is kept on hand, and the workman, first passing the composition through a flour-sifter into a mortar, adds the dextrine water and mixes the composition until it is about the consistency of putty.

Near the mortar is a smooth-faced iron plate, three-eighths of an inch thick, a foot long, and ten inches wide. On each side of the plate, which lies flat on a bench, is a strip of brass that extends along the plate on its edge. These brass strips are called "bearers." Their office is to provide a bearing for the "smoothing iron," which is a brass straight edge used by the workman to smooth out and knead the composition which is placed on the plate.

The workman takes a good sized handful of the reddish mixture and works it over the plate with his hands until it is a thick sheet that covers the plate entirely. Then he works the smoothing iron up and down over the composition until it presents a perfectly smooth surface, free from bubbles and lumps.

The form, with its locked-up type, is laid on the bed of an old fashioned Washington hand press, commonly used in printing offices to take proofs. The form has pins sticking up from each corner, and the iron plate, with its sheet of composition, has holes in its four corners to correspond to these pins.

A sheet of thin pure rubber, called a "gam" and used by dentists, is first laid over the type, and then the composition is laid on the rubber.

When the lever of the press is pulled forward the composition is forced down upon, and into, the type

through the thin rubber dam. This gives the first impression, which, of course, is not sharp and clear, for the rubber makes the type thicker.

The leaf of the press is then raised, and the plate, with its face of composition, is lifted from the type, the rubber sheet is removed and then the workman waits until the cement begins to harden.

He tests it with his finger, and when the composition is about the consistency of thick putty he gives it a second impression. The partly made mould is taken from the press again and permitted to grow harder before the third and last impression is taken.

Before each impression, after the first, the type is washed well with benzine. After the third impression the workman, with a knife having a crescent-shaped blade, such as is used by leather workers, goes over the surface of the mould, trimming down the elevations until the whole face is even.

All the dirt, bits of composition, and dust are blown from the mould with a pair of bellows, and then it is placed in the "vulcanizer" to heat and harden. This takes an hour, and when it is removed the soft, plastic composition is almost as hard as terra cotta and looks like that material.

The vulcanizer is a steam heated press, which looks like an exaggerated letter copying press, plus a cast iron square steam boiler under the lower plate. Pressure is applied in two ways—first, by a central vertical screw worked with a handwheel, and second, by four bolts, one in each corner, which are screwed down with a wrench.

Steam is raised by gas under the boiler to a pressure of seventy pounds to the square inch. Of course, no pressure is applied to the mould when it is drying in the press, for it is simply laid in and the steam is turned on.

The rubber of which the stamps are made comes to the maker in sheets, backed up with thin linen. It is in the form of the pure gum with the sulphur mechanically mixed in it. A square of this rubber is laid on the face of the mould, the rubber down, and a piece of tin or another piece of linen is laid on the rubber.

Then the mould with its rubber is placed in the vulcanizer, the upper platen is screwed down and then pressed down farther by the corner screws. The pressure forces the rubber into the mould, and as it is soft it fills up every mark and impression. Steam is turned on, and in six minutes the rubber is vulcanized and "set."

When the pressure is released the mould is laid on a table and the vulcanized rubber is peeled from it, and each stamp is cut out of the sheet with a pair of shears.

While the process of making the rubber stamp is going on, a second workman prepares the wooden blocks on which the rubber is mounted when the stamps are made. The wood—red birch and cherry—comes in the form of strips, three-eighths of an inch thick and varying in width from five-eighths of an inch to three inches.

Before the type form is placed in the press an ink proof is taken, and from this proof the workman gets his measurements for each stamp. With a small circular saw driven by steam power the wood is cut to the different sizes, the holes are bored for the handles, and the handles are driven in.

The wood is finished with varnish, and a brassheaded tack is given in one side of the block to mark the front. The rubber stamp is glued to the wooden block with a composition of gelatine and acetic acid, and when this is done the stamp is finished. The same glue is used to attach the rubber to the metal self-inking stamps.

The ink used for rubber stamps is made of glycerine and aniline color, with a little alcohol in it, and the ink pad is made of a piece of felt stuck to a block of wood and covered with cloth. Autographic signatures and designs which cannot be made by the compositor are made by an engraver or from electrotypes.

One of the largest rubber stamps ever made in Chicago was two and one-half feet long and one and one-half feet wide. It was not used as a stamp, but was mounted on a cylinder and used for printing paper bags.—The Stationery Trades Journal.

THE LEVAVASSEUR FLEXIBLE METALLIC TUBES.

THE manufacture of flexible metallic tubes capable of being easily shifted, of assuming the most diverse forms and curves, and, in a word, of adapting themselves to all exigencies, like rubber tubes, while at the same time possessing the strength of tubes of iron, copper and other metals, is a problem that many inventors have tried to solve. The process that naturally suggested itself to the mind consisted in winding strips of metal spirally; but it became necessary to find a means of giving the spirals an overlap sufficiently elastic and tight to permit of considerable of a displacement of two contiguous spirals without a leakage of gases or liquids under pressure supervening. This difficulty has been solved in a very satisfactory manner by Mr. Levavasseur, a French manufacturer. We propose to make known the different phases of the manufacture of metallic tubes by this method in the works established by Mr. Rudolph at Paris. We shall treat the subject under the following heads: The raw material; profiling; winding; tests and mounting of the couplings; different types and uses.

1. Raw Materials.—The raw materials employed are phosphor bronze, aluminum bronze, galvanized steel, brass and white metal, but chiefly phosphor bronze and galvanized steel, on account of their great strength.

The rolled phosphor bronze reaches the works in strips of great length in a single piece and weighing as many as 65 pounds, thanks to the improved equipment of one of the largest metallurgic establishments of France. This metal is of extreme hardness, is inoxidizable, is of a beautiful color and is almost as strong as steel.

The steel rolled in strips or skelps comes from Sweden. It is a very soft, homogeneous steel, and as the use of it would have few applications, because of its very rapid oxidation in air or liquids, it is covered while hot with a coat of zinc, which must be perfectly uniform. In order to reach this result, a special installation has been necessitated. The strip of steel unwinds from a bobbin, passes into an acid bath, where it is pickled, and then into a bath of molten zinc, and, in making its exit from the latter, is wiped off by pads of asbestos very strongly compressed by means of screws. It then travels a certain distance in the open air in order to become cool, and finally winds around another bobbin. As this work is entirely mechanical, an absolute regularity is obtained.

2. Profiling.—As the skelp is flat, it is necessary to give it the form of the profile in order to afterward roll it upon itself. For this purpose there is used a circular drawing frame of special construction. The skelp passes between different milling wheels of appropriate form, and is drawn out upon the circular frame, which possesses great power. The milling wheels are of cast steel, tempered and reheated. The turning of these wheels thus tempered is an operation that requires skill and very long practice. Their form is so delicate and must be so accurate that, if they were so tempered after being turned, there would always be a distortion that it would be impossible to rectify.

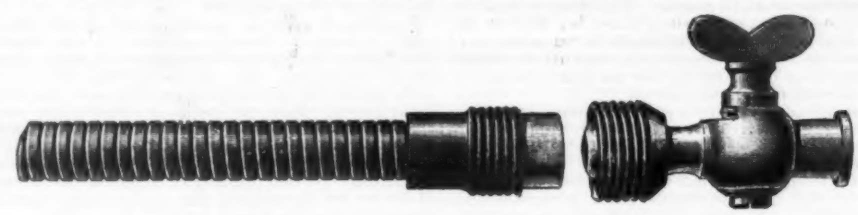


FIG. 1.—TUBE AND COUPLING FOR GAS. TYPE No. 1.

3. Winding.—The winding machine consists of a lathe bed, with a carriage mounted upon tempered rollers. Upon this carriage is mounted a gage plate which carries three milling wheel shells, that permit the wheels to recede from or approach the center, according to the size of the mandrel employed.

The profiled skelp engages with the first wheel, and then with the second and third. In this passage there is produced a partial overlapping. There is then introduced a thread of asbestos or rubber, according to the tube that is being manufactured, and the skelp continues to wind in, forming a tube which represents a screw with a more or less elongated pitch. When the end of the mandrel is reached, the carriage is drawn to the other extremity, and the operation is continued thus until the tube is finished.

4. Tests.—After the tubes are finished, they are tested under pressure, in order to ascertain whether they are subject to leakage. The pressures vary, according to the uses and diameters. The minimum trial pressure is 10 kilogrammes per square centimeter; the maximum of breakage is 250 kilogrammes. The tubes of type No. 1 (Fig. 1) are especially designed as conduits for liquids and cold gases. The joint is formed with a rubber thread strongly compressed in a cavity formed for its reception.

FIG. 2.—SIMPLE TUBE. TYPE No. 2.

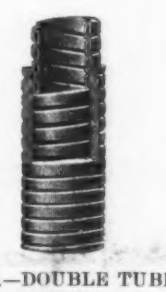


FIG. 3.—DOUBLE TUBE. TYPE No. 3.

The tubes of type No. 3 (Fig. 3) are double, the interior being formed of a tube of the type No. 1, covered with an envelope which is not tight, but very strong. In this way are obtained tubes for pressures above 20 kilogrammes per square centimeter and up to 150 kilogrammes.

The flexible metallic tubes of type No. 2 (Fig. 2) are designed for use with steam, hot water, and liquids that injure rubber, such as petroleum, fatty bodies, etc. They are covered only with another tube (not tight), giving them a great resistance to pressure, which may ascend to 250 kilogrammes per square centimeter.

Mr. Rudolph is likewise constructing a special type designed to serve as a protecting sheath for electric cables, and to prevent them from being injured by shocks, friction, etc.

Finally, there exists also a form of flexible metallic tubes without joints of any sort, that have but a limited amount of elasticity and are designed for steam use on railways. The tightness is not absolute, but the leakage is very slight. The couplings are soldered upon the exterior of the tube.—La Revue Technique.

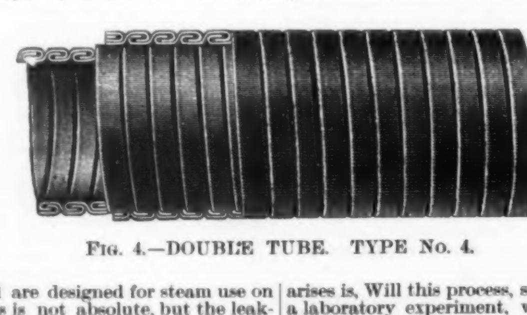


FIG. 4.—DOUBLE TUBE. TYPE No. 4.

A NEW fast train service between New York and Buffalo, over the Lehigh Valley Railroad, was started May 17. The trains make the run of 448·6 miles in ten hours, leaving each end of the line at noon. On the first trip the northbound train made the run in nine hours forty-six minutes, or nine hours eight minutes running time. Each train consists of a combination baggage, dining, and smoking car, 77 feet long, with library, writing desks, etc., two Pullman day cars, and an observation parlor car, with a woman's sitting room and seating capacity for twenty-eight persons.

ELECTROLYTIC MANUFACTURE OF WHITE LEAD.*

By R. P. WILLIAMS.

THIS new process of making white lead is a radical departure from all the old ones in not employing acetic acid at all, but in acting upon lead with nitric acid, which is generated by electricity.

The process consists of four reactions, as given below. First, the electrical preparation of nitric acid and sodium hydroxide. Second, the action of the nitric acid on lead, forming lead nitrate. Third, the reaction of lead nitrate and sodium hydroxide to form lead hydroxide. Fourth, the combination of lead hydroxide and sodium bicarbonate to form lead carbonate.

In the first step of the process, a solution of sodium nitrate is decomposed by an electric current from a dynamo. The strength of solution required is not important, 10° Baume, or say 1 lb. to the gallon, being sufficient. This solution is put into a series of cells, constructed of wood, and divided into two compartments by a porous partition. At the plus electrode is fastened a pig of lead and at the minus a sheet of copper. The solution being run in from an overhead reservoir, and the current turned on, the nitrate is decomposed according to equation 1, nitric acid collecting at the plus electrode and sodium hydroxide at the minus. The nitric acid at once attacks the lead and forms lead nitrate, which dissolves, equation 2, whereas the sodium hydroxide produces no effect on the copper at the negative pole. Finally, the lead nitrate solution and the sodium hydroxide solution are drawn off separately, and mixed as desired, in quantitative proportions, in a receptacle. The result, as shown in equation 3, gives lead hydroxide as a white, amorphous precipitate, and leaves sodium nitrate in solution. This is practically the original nitrate, and its regeneration shows one of the economic excellencies of the process, for the nitrate can be used over and over again, as the source of more acid.

It has been found, at the experiment station, that but little additional sodium nitrate is required for a repetition of the process as complete as the original. The lead hydroxide is then filtered from the sodium nitrate. This is done automatically and continuously, by a rotary filtering device, and the sodium nitrate is pumped back into the original reservoir. The fourth step is, in some respects, the most interesting of all, and consists in adding to the lead hydroxide a solution of sodium bicarbonate (or of the normal carbonate). Reaction (4) at once takes place. It will be noted that sodium hydroxide is the product in solution, and lead carbonate the precipitate. Another beauty of this process is that the sodium hydroxide removes most of the impurities, if there are any, in the lead hydroxide; for instance, it will dissolve any salts of aluminum or of zinc, and it removes organic matter.

These impurities appear in the solution, leaving the precipitate remarkably white. Once more, this by-product, sodium hydroxide, by passing carbon dioxide into it, is converted into bicarbonate and the latter can be used again. Thus the main agent in each of the two principal steps, sodium nitrate and sodium bicarbonate, is made to do duty over and over again, with but slight additions.

(1) $NaNo_3 + H_2O = Na\bar{O}H + H\overset{+}{N}O_3$.
(2) $2HNO_3 + Pb = Pb\,(NO_3)_2 + H_2$.
(3) $Pb\,(NO_3)_2 + 2NaOH = Pb\,(OH)_2 + 2NaNO_3$.
(4) $Pb\,(OH)_2 + HNaCO_3 = PbCO_3 + NaOH + H_2O$.

It is doubtful whether (1) and (2) take place as above, but probably the reaction is as follows, since hydrogen is liberated at the minus electrode:

$$2NaNO_3 + 2H_2O + Pb = (2Na\bar{O}H + H_2) + PbO_2 \overset{+}{(NO_3)_2}.$$

Let us now turn from the theoretical to the practical part of the matter. The first question which naturally arises is, Will this process, so beautiful in theory, and as a laboratory experiment, work on a large scale and give sufficiently practical results to compete with the other methods of manufacture, and make it a lasting contribution to inventive science?

An experimental station was for several months in operation in Cambridge, Mass., erected and run under the direction of Mr. Arthur Benjamin Brown, the inventor of the process. This was capable of turning out some 500 lb. of white lead per day. Its success was regarded as beyond question. The cost of white lead by this process is more than covered by the gain in weight, and is but a fraction of the cost by the Dutch method. The reasons are, first, in the electrolytic pro-

* Abstract from the Engineering and Mining Journal.—American Chem. Soc.

cess pig lead is used as it comes from the smelting furnace. In the Dutch it has to be remelted, cast into "buckles" of definite size, and, after the action of acetic acid, from one-third to one-half is left uncorroded and has to be recast.

Second, the process is almost instantaneous, as every reaction takes place rapidly, while by the other mode from two to six months are required.

Third, in materials and labor there is great saving. No free acid is used, either acetic or nitric, and the agents sodium nitrate and bicarbonate are used repeatedly. By the old method a plant covering a large area is filled for months with fermenting tan bark or manure, acetic acid and lead, while the process is going on, and at its completion, the product is removed with much labor, and has to be thoroughly and repeatedly washed to dissolve out any lead acetate remaining. It must be ground and reground under water, and even then is not likely to be of uniform texture. It is also a poisonous and dirty process. The electric method, being continuous, is complete the same day, requires but a very small force of men, as almost all the operations are automatic, and is a clean and non-poisonous process.

The texture of the product is almost molecular in fineness, as might be expected from its being produced by replacement in the hydroxide. Hence it needs no grinding. It is so fine as to remain suspended in water for a long time, and in order to filter it a special brand of cloth had to be made, as even filter paper would scarcely retain it.

One of the most important practical questions is, How does paint made from electrolytic white lead compare with that made from Dutch lead in durability, opacity and covering power? Specimens have been submitted to some of the largest dealers and painters in New England and elsewhere, and Mr. Brown, the inventor, has spent the last two years, aided by a competent corps of assistants, not only in the development of his new process, but in making thorough and systematic tests of the product. Inside and outside surfaces have been exposed to the severest extremes of weather, to the varied fumes of the laboratory, and to other crucial tests. Dutch paint and electrolytic paint have been exposed side by side for two years, and no difference can be detected in durability or opacity. The covering power of the new paint is considerably greater than that of the Dutch. Experiments vary as to the increased percentage from 12 to 20, or even higher, but in no case was there found to be a smaller percentage.

What is the cause of such an increase? This leads us to discuss somewhat more fully the nature and composition of white lead made by the various processes. Dutch white lead consists, approximately, of two molecules of the carbonate to one of the hydroxide, $2PbCO_3Pb(OH)_2$. This, however, appears not to be constant, as might be inferred from its mode of manufacture. Lead hydroxide is a white, amorphous substance. Lead carbonate is either a spongy, transparent, globular powder or is crystalline. Whether globular or crystalline depends upon its mode of preparation. Now certain properties of these two forms are quite different, and this difference explains the use of one and the disuse of the other form as a pigment. The globules of the one form are said to be from 0·00001 to 0·00004 of an inch in diameter. These, in the grinding of lead with linseed oil, are supposed to take up the oil, somewhat as a sponge absorbs water. The Dutch process lead is the globular variety, and to this fact has been attributed the greater body and permanence of the paint made from it than that made by most other processes. The crystalline variety of the carbonate is found not to absorb oil to anything like the same extent as the globular, no matter to what degree of fineness it is ground, the surface of the minute crystals being impervious.

Half a century ago Thenard invented the "quick process lead," or "French process." This is now carried on in Clichy, France, and some other places, and sold as "Clichy white." It is made by dissolving litharge in acetic acid and then, passing into the subacetate of lead solution, formed carbonic acid gas. Thus is formed neutral lead carbonate. It was at first thought to be a revolutionary process, but it soon became apparent that the product did not give the capacity or body which Dutch lead gave, and, of course, it lacked permanence. Made in this way, the carbonate is crystalline. Under the brush it is found not to cover as much surface and not to spread as well, or it is said to lack "body," although of the same composition as the other. Other rapid processes—and there have been hosts of them—have invariably met with no better success, for the reason that the carbonate formed is the crystalline instead of the globular variety. To this fact we may mainly attribute the long continued use of Dutch process lead. The committee of experts appointed by the British home secretary visited forty-six works, and found only one using the precipitation process, and three the chamber process. They say: "While some of the substitutes are cheaper to make, and far less poisonous, yet they are far from equaling the Dutch lead as a pigment. Neither can they recommend other process than the old Dutch process for manufacturing the product."

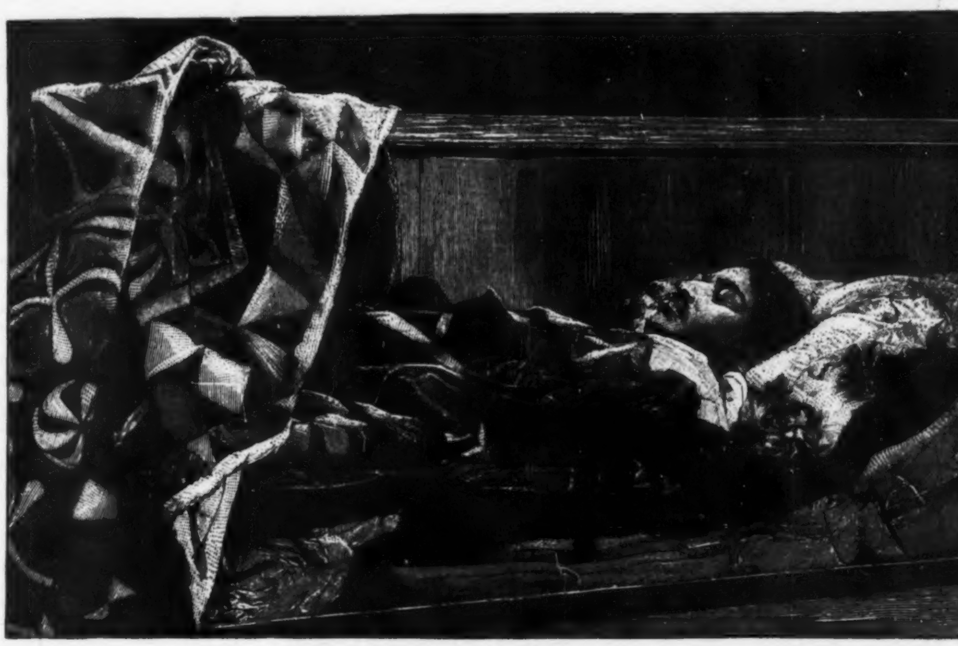
Thus we see that until now no cheaper method has been found for producing the globular variety. The electrolytic process does produce the globular kind, and a finer variety even than the Dutch, so fine, in fact, that it was almost impossible to find a filter that would retain it. This probably accounts for the superiority of the electrolytic brand, as regards body and covering power over any other kind produced. Experiment shows that the pure carbonate will do as well as a mixture of carbonate and hydroxide. By the new process it is easy to make either the pure carbonate ore mixture in any proportion of carbonate and hydroxide. This new process was invented in 1892 by Arthur Benjamin Brown, a chemist and mining engineer of Boston, and is only now made public.

The European Economist publishes some facts with regard to the growth of population in the various countries of Europe during the decennial period of 1885–95. The aggregate increase was 29,922,800. Some states have advanced greatly. For example: Russia added 12,510,800 to her existing population; Germany, 4,522,600; Austro-Hungary, 3,502,200; Great Britain, 2,452,400; Turkey, 1,100,000; and France, 67,100.

THE SLEEPING FAKIRS AT BUDAPEST.

AMONG the most interesting objects at the Millennium Exposition are the fakirs who are supposed to remain in a cataleptic sleep for periods ranging from eight to thirty days. It is a well-known fact that there are religious ascetics in India who, to all appearances, are dead and sometimes are even buried for weeks or months, and yet, on the appointed day, they wake from their lethargy. The nature of this sleep has never been scientifically explained, but it is supposed to be induced by suggestion and autosuggestion in connection with special training. If the physicians and physiologists who control the Budapest experiments will watch carefully in the interest of science, reliable information in regard to the subject may be obtained. When these sleepers exhibited themselves for six months in the Royal Aquarium the scientists of London neglected the opportunity of investigating the subject. The three men, intelligent looking, powerfully developed men, whose ages range from twenty-three to twenty-eight years, are incorrectly called fakirs, for they are not mendicant friars, but, according to their own account, finely educated, devout theologians who believe that such sleep brings them nearer to the Deity and that they are performing an act of consecration. They seem to find nothing incongruous in the performance of the act before unbelievers for the sake of money.

After pretended mortification, fasting and long prayer, a fakir wraps himself in silken garments and lies down in the glass coffin, with an open top, which is to be his resting place for so many days, and his companions utter prayers over him and give him the password that is to rouse him. Suggestion on the part of his associates and strong autosuggestion induce immediate sleep. He lies there like a dead person with closed eyes and perfectly oblivious of all that is passing about him, and while this quiet sleep lasts he takes no nourishment of any kind. The sleeping fakirs lie in the Indian temple where they can be seen by all. Thus far one fakir has slept eight consecutive days and one fifteen



THE SLEEPING FAKIR OF BUDAPEST.

days; another will be buried and sleep under ground for a month. He will be supplied with air by means of a tube, and a mirror will be so arranged in connection with an electric light that his condition can be constantly watched. This sensational performance, which was repeated in London, will be held in reserve here for the truly "great attraction," to which the sleep for eight and fifteen days is only a kind of introduction. In order that the very dramatic awakening may be witnessed by a large number of spectators, the glass coffin with the sleeping fakir will be placed on the stage of a marionette theater, where the subject will be roused in the presence of the committee of watchers. There ceremonies are opened by the prayers of the fakirs and then attention is turned to the sleeper, breathing upon him, rubbing him, opening his eyelids, pulling out his tongue, etc. After working upon him for about half an hour he begins to breathe and his limbs begin to move; he is then raised and placed in an easy chair and fed with milk—these fakirs pretend to live on nothing but rice and milk—and then he hears the password, which announces the end of his slumber; the earth has him again. These scenes have caused so much excitement that spectators have fainted. While sleeping, the pulse of the subject fell from 70 to 60 beats and the respiratory movement from 18 to 3 per minute, and the temperature of the body fell from 99·5° to 96·6°. His eight days' sleep cost Gostal Krichna 10 pounds. Such cataleptic sleep apparently has a decided effect on the human body. It is hoped that the scientists of Budapest will expose the secrets of the glass coffin to the light of science, so that these strange exhibitions may benefit physiological investigators, instead of simply furnishing entertainment for sensation-loving visitors to the Exposition.—Illustrirte Zeitung.

Paris's Avenue de l'Opera, the first street in the world to be lighted by electricity, is now to be permanently lighted by that agency. The Jablochkoff light was used during the exhibition of 1878, but was removed afterward on account of the expense, and gas was used once more. As the town is hard pressed for money, electricity will be used on only one side of the avenue at first.

$250 PRIZE ESSAY COMPETITION—PROGRESS OF INVENTION DURING THE PAST FIFTY YEARS.

Third Prize, won by "INVESTIGATOR" (GEORGE M. HOPKINS).

IN considering the present aspect of invention as compared with that of the close of the previous half century, the impulse is to ask ourselves what invention is, in order to secure an adequate understanding of inventive progress. An invention is apt to be thought of as an assemblage or organization, of pieces of mechanism, for example, or some arrangement of forms, or a conglomeration of materials; but invention is more than all these. The very meaning of the word is the calling into existence of something. It is a well settled fact that human intelligences are unable to cause to exist an atom of matter, or any original manifestation of energy.

Invention, in the sense in which we are now considering it, is the exercise of that faculty by which we bring about new relations of already existing matter, new forms of energy from nature's great reservoirs, or the giving to matter new, useful or ornamental shapes.

In examining the world of invention as it stood fifty years ago, we find mechanism for the rapid manufacture of articles of every day use almost wholly wanting. Nearly everything was hand made, expensive and crude, excepting such articles as were made by expert workmen at prices that were practically prohibitory. Such a thing as producing two articles of the same class that were exactly alike was impossible. The great system of interchangeability of parts was practically unknown.

An instrument of any particular kind was constructed by a maker whose business consisted in constructing such instruments year after year for a lifetime. These instruments were nearly alike, good and durable; but they were expensive. Any repairs had to be done by the original maker or by a skilled mechanic. The first great impetus given to invention was by the introduction of the interchangeable system, whigh greatly improved the product, lessened the cost of manufacture, placed the brains in the factory office or drafting room, and put both brain and muscle in the shop.

When all this had been accomplished both inventors and the public could appreciate it. In those days the citizens of the United States rapidly gained ascendency over other nations in matters of manufacture.

Novel articles are practically worthless for trade unless they can be produced at a cost which induces the purchaser to willingly exchange money for them. So long as prices are high, purchasers look twice before buying, sales are not rapid, and in consequence profits are not alluring; but when any article can be manufactured by the million, it requires very little mathematics to show that an infinitesimal profit on each article would aggregate in such sums as would lead to the invention, not only of things known to be in demand, but also of new objects.

The first extensive application of the interchangeable system was in the armories, and when sewing machines were brought out this system was applied in a very thorough manner, the machines being made so accurately that any part of a machine could be substituted for the similar part of any other machine of the same series without refitting or alteration. Not only was this accomplished, but great economy in manufacture was secured. When manufacturers began to see the advantages of this system they adopted it without hesitation, and the consequence is we have to-day in this country thousands of shops of very high order.

The first sewing machine of real practical value was that patented by Elias Howe in 1846; subsequently I. M. Singer brought out his machine, and later A. B. Wilson invented a machine provided with the four motion feed. These inventions were protected by patents which enabled their owners to control their business, and bring the process of manufacture to a very high degree of perfection.

The mower and reaper went through the same range of development. They had much efficiency before 1850. The first reciprocating cutter bar was brought out in 1822. McCormick invented his world-renowned reaper in 1834, and improved it in 1845 and 1847. The quadrant-shaped platform was devised in 1851 and the combined reel and rake in 1856.

Turning for the moment from machines, we find the

Bessemer steel process invented in 1855 and 1856 an epoch marking invention, as it formed the basis of many new industries and expanded branches of manufacture already in existence. Bessemer steel plates, rails, beams, bars and rods have superseded iron almost entirely, and better forgings and pressed work are now produced from this material than were ever made from iron.

Wrought iron railroad rails were used in 1808, but they did not come into prominence until 1820. The first railroad in America was built in 1825; the next in 1827, and in 1830 Peter Cooper completed the first passenger locomotive. It was capable of drawing a train at the speed of 18 miles per hour.

The Pacific Railroad was projected in 1846; an act was passed in 1853 authorizing its construction, but work was not begun until 1863, and the road was not opened until 1869, since which time steel rails have been introduced on nearly all roads in the United States; enormous locomotives have been constructed, both simple and compound, and other improvements have been made which bring the locomotive to a high state of perfection. The speed of 75 miles per hour has frequently been maintained by modern locomotives, and higher speed than that has been reached during spurts upon favorable stretches of road.

At the beginning of the half century just closing, Robert Fulton and John Stevens had already finished their experiments in steam navigation. Fulton had started a steamboat on regular trips on the Hudson (in 1807). Allair had made the first of a series of compound engines for steamboats (1825), and the great enterprise of steam navigation had been fairly launched. Magnificent progress had been made, so that early within this half century the greatest steam vessel ever built—the Great Eastern—was finished, and soon found to be a failure. Although this failure had a tendency to retard progress in this direction for a time, the lesson was a beneficial one, and the builders of steam vessels proceeded more cautiously and more surely, gradually increasing the size of the vessels and the power of the engines, until the later examples, such as the St. Louis and St. Paul, the Lucania and Campania, almost equal the Great Eastern in size, while in efficiency and speed they far outstrip the best efforts put forth by that enormous but worthless vessel.

It was in 1840 that the screw propeller was applied, and side wheels have been since improved by feathering paddles and by gradual development in other directions, until it is a much more important means of propulsion than it was when it stood alone in the field.

Turning from navigation to motive powers, we find the steam engine becoming more perfect with the growth of time. We have new forms of boiler and many new styles of engine. The Corliss engine approached perfection before the Centennial Exhibition, and many styles of engine similar to the Corliss have been produced since that time. A later type consists of the high speed engine brought out by the development of electricity, and which finds many applications outside of this particular field.

Although the gas engine was known fifty years ago, it was not until within thirty years that it was put in practical and economical use. Now such engines are superseding steam engines in many places, and petroleum motors are fast becoming the favorite prime motive power for small and medium sized plants.

The turbine, like all other machinery, has been developed and perfected slowly, and by the dictations of experience, so that now probably the highest efficiency attainable has been reached.

Electric motors and dynamos are really products of this half century. It was not until 1860 that the first motor on genuine scientific principles was constructed. It was the Paccinnotti ring armature machine which involved the principle of recent motors, while its armature had the form, and some important features of the present dynamo armature. The self exciting feature of the dynamo was invented by Soren Hjorth in 1854. The Gramme ring armature machine was brought out in 1870, and the Siemens drum armature machine was invented in 1873. The Edison, Weston, Thompson-Houston and similar motors and dynamos are comparatively recent, but the alternating generators and motors of Tesla and others are the latest of all. They hold the promise of a new era in the transmission of power, especially on railroads, and in other connections where the electrical energy is to be transformed into mechanical work at a considerable distance from the generating plant. We may expect soon to see all kinds of railroad propulsion accomplished by means of electricity. Within a very few years the electric current has been so perfectly and economically distributed as to permit of driving large and small machinery on not too long circuits, at rates that will compete with any motive power.

The trolley street railroads, and railroads in the mining regions, are good examples of direct current systems working with reasonable economy on lines of moderate length.

The secondary or storage battery, the development of which must be credited to Plante (1859), has been reduced to actual, practical use, and made to serve a good purpose in central station incandescent lighting (1894), propelling boats and other uses, but it does not entirely fulfill its early promise.

Arc lighting has been improved since the days of Sir H. Davy, until it is now employed for street lighting and the illumination of large areas in almost every city and hamlet in the United States, and in fact in the world. The number of forms of arc lamps is very great, the one having the opalescent globe inclosing the arc, and more of less closely the products of combustion surrounding the arc, being the most recent improvement in that line.

The incandescent lamp now used was developed in 1879–80. This invention, and, in fact, almost every invention of an electrical nature, has formed the basis of a new industry. Many of these industries were established on an enormous scale; not only so, but some of them were early doubled and even quadrupled in capacity. This caused a growth of some towns which were rivaled only by phenomenal mining towns in the West and Southwest.

The application of electricity to the reduction of ores is a distinctly modern invention, and the reduction of exceedingly refractory substances by means of the electric furnace is as novel and interesting as it is recent. The electric furnace has been instrumental in bringing out new and valuable products hitherto unknown, and which could not have been produced outside of the electric arc.

Electric welding, invented in the recent past, provides a novel and efficient means of making a weld, and also makes a new kind of weld, that is, it can unite dissimilar metals as well as like metals, and produces a joint of pure metal or alloy which is stronger than other portions of the work. Electric soldering is also done. These processes find extensive application in the arts.

The electric telegraph has been for fifty years a continual development. It originated with Morse in 1832, and grew like other inventions, unless it may be that it advanced more rapidly than other inventions of the same importance. The first great achievement within our period was the laying of the Atlantic cable, and communicating with our friends on the opposite shores. The next was the duplexing of land lines and the next quadruplexing them. Then came the application of the dynamo to telegraphy, whereby batteries were dispensed with. Then the ocean telegraphs were duplexed. In the meantime rapid printing telegraphs had been introduced. Typewriting telegraphs had been perfected. Autographic writing telegraphs had been put into use, and more recently drawings and photographic impressions have been reproduced at a distance over the electric wire.

Telephony had its birth at about the middle of the period we have under consideration. The important telephone patents have expired and the people are heirs to the inventions.

In the immediate past we have an unexpected development in electrical phenomena. By a peculiar manifestation of electrical energy we are enabled to photograph the bones and other interior parts of the human body and of animals, also to actually see the shadows of our own interiors. This new discovery of Roentgen's may hold in store much benefit for mankind.

Turning from electricity to photography, we find that the principal advancement in photography has taken place within fifty years. The Daguerreotype, which was the best style of sun picture in 1846, was abandoned not long after that date in favor of collodion positives, and prints from collodion negatives. The pictures in the colors of nature so much desired and striven for by the early inventors have recently been made with considerable success. A great deal of illustrating is now accomplished by photo-engraving and photo-mechanical printing without the aid of hand engraving.

In chemical industries the advance of invention and discovery, although not so apparent to the general observer, has been wonderful and rapid. Among the great achievements is the utilization of waste products, the economic use of rare minerals and other substances, and the cheapening of products already known.

In optics we find the new Ziess glass a thing of recent years, and have for our own use microscopic objectives of marvelous power made from this material.

It is seen that in following the line of advancement in the few classes of invention alluded to, the progression appears to be almost in a geometrical ratio. One invention suggests another and so on until the world seems so full of inventions that there is no possible room for more; but after all the geometrical ratio holds, not only as to the number of inventions, but also as to their importance. Last of all the electric motors and generators came Tesla's. After incandescent lamps came Edison's fluorescing lamp. After the use of electric lamps within the human system, for making investigations by ordinary transmitted light, came Roentgen's discovery of a way to flash X rays through the body with energy enough to photograph and even see interior parts.

Why should we think the limit of invention has been reached in any direction? Why should we not rather live in a state of expectancy, hoping for still greater things? Men have different motives for invention. The prevailing one is that of gain. A fascinating one is that of winning honor; another is that of benefiting the human race. They may take their choice of motives, or they may, thanks to our liberal patent laws and an appreciating public, allow themselves to be impelled by all three motives at once.

THE DEFENSE OF OUR MARITIME FRONTIERS.

WHEN we consider the two divisions of national armament, the army and the navy, our attention is first drawn to their respective spheres, so dissimilar as to be almost antagonistic; the employment of the one, by the laws of nature, perforce excluding the other. As we examine this subject still deeper, this impression is strengthened, and we see that these two forces, like the land and sea, each good in its own element, meet at the water's edge. Our ships sail out on the seas and meet our enemies in conflict, our armies march against similar hostile armies: the one on land, the other on water, both fulfill their duty, but neither could take the place of the other. They are primarily distinct, and judgment demands that they be so kept. A sailor is of most value on board ship, and a soldier when his feet are on the firm ground, and to take either out of his element and expect him to maintain the same standard of excellence would be poor policy.

The proper sphere of the soldier ends with the land; here the sailor joins him. Their fields of action meet but do not mingle; indeed, the line is so sharply drawn as to repel each a little space. This line, what does it mean? It is the sea coast; not the ripple on the sand which marks the limits of the wave, but the country adjacent, with all its inhabitants, its homes, its factories. A complete system of national armament would comprise means of defense for every part of the national territory in proportion to its strategic or intrinsic value. A patriotic system would so defend the least of these that it would be invulnerable. How is it with us? how are our coasts defended? Is it by the army or by the navy? Which of them assumes the qualities of the other, or does each take a share? The answer is short: we are, as regards modern warfare, practically undefended.

This condition has been recently attracting the attention of our government, and the details have been given to the public so fully that it would be a waste of space to repeat them here. Various schemes, involving the expenditure of millions of dollars, and necessitating many years of labor to perfect, have been proposed and partially adopted. This is all very well, and provided we can carry out these schemes, appropriate enough money each year to do the work, see that this work is done, and provided, also, that the rest of the world leaves us peaceably alone, and waits until our defenses are completed before offering the gage of war, we shall do very well. But suppose that they do not? They might possibly come to the conclusion that they would be spared some trouble were they not to wait. Then what could we do? Call on our navy. Good. Our ships are recalled from foreign stations as rapidly as possible, and we muster a respectably large fleet. What will be done with them? First, they will be divided, part at the East, part in the Pacific; part for offense, part for defense. We must count on some of our foreign fleet being waylaid by superior forces; first loss. This leaves us a smaller fleet. Some are sent out on the high seas as commerce destroyers, and to act against the coast of the enemy; second loss. We have left only a small portion of our fleet, and with this we must protect our great reach of coast.

The economic side of the next war will be its characteristic feature—that is to say, the great efforts of the combatants will be directed more to the destruction of property than of lives. This condition would obtain especially with us on account of our comparative lack of international animosities, such as exists between France and Germany; our vast extent of undivided territory, which is a safeguard against any serious attempt at invasion; our natural wealth; and, finally and most important of all, our great length of sea coast.

Those places would naturally be most protected whose occupation or destruction would give the enemy possession of valuable strategic points, or would result in the greatest loss to our own cause. These places are easily chosen in our case; they are the important cities of our Atlantic and Gulf coasts. Of course, tremendous damage would result from a descent by the enemy from Canada, through the great lakes, or on the Pacific coast, but it would be nothing at all compared with the effects of like efforts expended against the Atlantic coast. I take here the supposition of a war with England or her allies, though, were it with any other nation, only our northern frontier would in any case be exempt; the ocean coasts would still remain exposed.

Wealth gravitates toward cities, and particularly toward coast cities, the centers of trade, and in this respect wealth and population are synonymous terms. These eastern coasts, in view of their numerous wealthy and unprotected ports, would bear the brunt of war, because here the greatest amount of damage could be inflicted with the minimum of delay and effort. In addition, here are located great manufacturing interests, on the coasts, or within easy distance, the destruction of which would seriously cripple the entire country, and, still more, on these coasts are grouped every governmental and private plant in the country for the manufacture of sporting and military rifles, revolvers, ammunition and machine guns. In one city, New Haven, which is entirely without protection, are the Winchester Arms Company, the Marlin Fire Arms Company, and the Ideal Manufacturing Company, the loss of which would nearly paralyze our means of defense. The occupation or destruction of New York and Washington present a spectacle too terrible to think about; the investment of New Orleans would effectually close the trade of the Mississippi; Chicago, Milwaukee, Cleveland, with their great populations and immense wealth, practically invite contribution.

The enemy comes, and our fleet goes to meet him. He appears at different parts of the coast with ships carrying heavy guns, and destroys cities or lays them under contribution, while his main fleet seeks ours and engages it in battle. What if only two or three of his ships are left free to ravage our coasts? They will be hard to find, for they can slip away easily in the night, and no one can tell their destination. They can inflict damage which would not be compensated by the utter destruction of ten times the enemy's fleet. We cannot rely on the navy to furnish complete security.

Then call on our army. There we are. If the armed forces of the greatest nation on the globe were to plant a hostile foot on our soil, we could, at a moment's notice, as we have done before, raise an army large enough to swallow them, and after that another one. But suppose the enemy does not land, but satisfies himself with remaining in his ships and bombarding our cities? I will merely quote the following remark of one of our most eminent military authorities: "An army of a million men, intrenched around the city of New York, and supplied with all the munitions of war, would be utterly unable to prevent bombardment or contribution by a second rate European power."

Our most valuable possession is our most vulnerable one; it is the line between the land and the sea. There is here a gap in our defenses through which the enemy could and would strike tremendous blows. Now, we have a means of filling this gap, and of so joining the fields of army and navy as to construct a complete system of defense. The defense of this gap belongs in strictness to neither army nor navy, but to a third body which actually exists, though its true value has been greatly misunderstood. I speak of the navy reserves, of that body of men without definition; of the sailors who are trained soldiers, who learn navigation by studying the pages of the infantry manual. This force is the third factor in the general theory of national armament, the factor which binds together the army and navy, and whose field of action embraces all not practicable for the others. It is to this body, not as it is, but as it should be, and as I hope it will be, that we must look for the defense of our coasts.

The Federal government, absit invidia, is making a grave mistake in its treatment of the reserves. In the words of the secretary of the navy, "The interest of the Navy Department in the naval reserves must, in the very nature of things, depend on its efficiency as a sea-going force, and it is the intention of the department to give its various organizations its most hearty co-operation in all efforts tending to such an end." This quotation clearly defines the policy of the government, and it is with this policy that I find fault. Even considering the recent birth of this force in this country, it is astonishing how little is known concerning it. About all one sees of it in print are small items, generally of a mildly sarcastic nature, which only serve to lower their reputation in public opinion, and make their actions appear more like farce comedy than sober earnest,

This humorously complaisant attitude taken by their fellow citizens against the reserves, and particularly those in the interior of the country, is justifiable though unfortunate. It is, indeed, intrinsically ridiculous and mirth-provoking to see a body of trained soldiers, many of whom have but once or twice in their lives been on board a ship of war, sporting rolling collars, and answering the name of "Seaman——" at roll call. Verily, they are neither fish, flesh, nor fowl.

I will not here discuss the question as to whether such a force should be called "naval reserves" or "naval militia," though I know the importance of such a distinction, but will call them "reserves" for the sake of brevity.

In the first place, they may be roughly divided into two general classes—those located in the coast cities, and those in the interior. From this natural division, we see that a goodly proportion of the reserves are located in the interior, far from the coast and from even an occasional glimpse of a ship of war. Few of the men belonging to the coast bodies have any conception of a man of war's man's life and of his duties, and such can be acquired only by long experience, while the proportion in the inland bodies is microscopic. There is necessarily a lack of means for technical construction. One who has been raised on shore will be out of his element on board ship for a long time, and will not be able to do all that of which he would otherwise be capable. In addition to this, the reserves are given military instruction exclusively. The efforts of the officers are devoted to so training their men that they will take good standing in the annual inspections, which are conducted by military officers, and which embrace only the schools of the soldier, company, and battalion. A knowledge of the duties of a sailor is not demanded or even expected, and the reserves, so far as their training can tell, would do much better service on shore than afloat. To be sure, the Navy Department gives them the advantage of a week's cruise each year on one of the government vessels, but this is all the actual service they see, and it amounts to almost nothing. Even this does not always materialize, and the embryo Jack Tars must perforce go into camp like their fellow soldiers. Of course, it is claimed that it would be impossible to devote more time than is actually allotted to the annual tour of active service, and this I grant, but this, in itself, is an argument against the present policy. As at present organized, there is an unfortunate clash of State and national supervision, which, though not technically possible, yet exists, and exerts a weakening influence in effects for improvement. Finally, the lack of a system in which the status and duties of the reserves would be finally established, so that each man of each organization would be trained to do a certain work, militates against the employment of their best services. With all this in view I cannot understand the present attitude of the Navy Department.

I could not attempt to describe fully, in a paper of this size, the means by which the reserves could best perform their proper duties, and shall only point out the outlines of a system which promises the best results with the least expenditure of effort.

As I have said, it is the avowed policy of the government to make the reserves a sea-going force, and I think *that this is* wrong. Their work should be in the defense of the sea-coasts, and in time of war, with fixed defenses in such a condition as ours, a body of well-trained men would prove of inestimable value.

In the first place, as to general preparation, the men should become perfectly familiar with the signal codes, both day and night, and with the use of the heliograph. They should make a study of the marline spike, and learn to knot and splice. They should learn to read charts, and should make a study of the coast so as to become familiar with its peculiarities. In good weather the men should be instructed in small boat drill; as the reserves are all located near water of some sort, this could easily be arranged. Theoretical and, where possible, practical demonstration of the use of torpedoes should be given. Purely military exercise should not occupy more than fifty per cent. of the whole time devoted to instruction.

As regards special preparation, the bodies near the coasts should make a special study of that locality and become thoroughly familiar with its topography and resources. They should also study the manner in which an enemy would most probably attack, and evolve the best means of defense. The bodies in the interior should be assigned to the nearest points of the coast, in numbers proportionate to their importance, and should make a like study of them. In case two or more bodies were assigned to the same place, their actual duties would be divided. The one resident there would have charge of scouting, signaling, dispatching, torpedo laying, etc., while the other would have charge of organizing and drilling sectional mosquito fleets, training volunteers, and like duties. We would thus have, at each place of importance, a body of men, however small, thoroughly acquainted with the locality and all its advantages and disadvantages, together with a knowledge of the technique of arms. These men, with the forces they would be able to gather around them, would be able to harass an enemy, prevent or at least seriously inconvenience him in establishing a base of operations in the vicinity, and would deter him from making demonstrations except in force.

In the formation of these fleets means will be as varied as the localities. The secretary of the navy has proposed an admirable scheme of quasi-subsidizing private yachts, swarms of which cover our Eastern waters. The men to man these boats will be easily found, but the leaders must be made. They must come prepared for their work by long and constant study. Other duties belonging to the reserves would be the transporting of land forces and the defense of important channels not otherwise defended.

The following will illustrate the manner in which the reserves would be employed:

1. The frontiers of the country will be divided into zones—
   A, the Atlantic coast; B, the Gulf coast; C, the Pacific coast; D, the Great Lakes.
2. The zones will in turn be subdivided into districts.
3. The defense of each district will be twofold—a, active; b, passive.
4. Storehouses for munitions of war, naval docks, hospitals, repair shops, etc., will be located at or near the headquarters of each district.

Thus each district will be in charge of a chief, who controls two subordinates, one commanding the active the other the passive defense. Each zone will be in charge of a chief, who controls all the district commanders. The chiefs of the four zones will in turn be subordinate to the commander of coast defenses.

By the "active" defense of the respective districts I mean the mosquito fleets, divided into gunboats, torpedo boats, dispatch boats, vessels for transportation of land forces and munitions, automobile torpedoes, etc., officered by members of the reserves. In addition there would be attached to each district one or more cruisers of the second class ready: First, to defend its own district; second, to aid in defense of an adjacent district; third, to unite with all the cruisers of its proper zone in repelling a general advance of the enemy acting in this last capacity as a reserve fleet, or second line of defense, to the navy proper.

By "passive" defense I mean forts, batteries, fixed torpedoes, bars and soldiers, proportionate in number to the size and importance of the locality, there stationed to man the forts and other fixed defenses, and to repel attacks by land forces.

The following plan will give an idea of the division of the coasts:

A.—Atlantic zone, headquarters at New York.
- First district, extending from Eastport to Cape Cod; headquarters at Boston.
- Second district, extending from Boston to New York; headquarters at New York.
- Third district, extending from New York to Cape Hatteras; headquarters at Norfolk.
- Fourth district, extending from Norfolk to Key West; headquarters at Charleston or Key West.

B.—Gulf zone, headquarters at Mobile.
- First district, headquarters at Mobile; extending from the Delta of the Mississippi eastward to Key West.
- Second district, headquarters at Galveston; extending from the Delta of the Mississippi westward to Brownsville.

In like manner the Pacific coast and the great lakes would be divided into districts. This plan, of which I have only given the bare outlines, offers many advantages, but I will call attention only to a few of those which peculiarly affect the reserves.

First. It embraces a system in which the reserves have a certain established position. This point is of great value, for by this means provision is made for the employment of a strong body of well trained men, who have at present no definite aim.

Secondly. Compliance with the requirements of this plan demands a thorough knowledge of our resources of defense by the men who are to aid in the work of defense. This means that the individual members of the organization shall make such a study of their duties as shall enable them to be leaders instead of followers, to train instead of requiring training.

Thirdly. This study, and the knowledge of a definite task to be performed, will prove more interesting than the present scheme of instruction; it will give the men more enthusiasm in their work, and will offer greater inducements for recruiting.

Fourthly. When such a scheme shall have been elaborated, it will prove not only more efficacious, but less expensive. In a word, it will be the transition from individualism to co-operation in labor.

In conclusion, I can only say that members of the reserves are heartily in favor of such a scheme, because it will give them a standing among military organizations; public mockery of their half soldier, half sailor condition will have no raison d'etre; they will be able to respect themselves by being respected; a definite course of study will be mapped out; they will have a certain object to work for, and one well within their powers to obtain; their labors will be interesting and instructive, as well as valuable; recruiting will be easier, and a high standard more easily obtained than under the present system; and, finally, the officers will be able to offer to their government well trained and intelligent men ready to spring to their work with alacrity and skill. Certainly this would necessitate a change in the present operations, though vastly less than one unfamiliar with the subject would imagine, but it must not be forgotten that "il faut reculer pour mieux sauter."—William Thaw Denniston, in the United Service.

STATUE OF BISMARCK IN THE INTERNATIONAL ART EXHIBITION IN BERLIN.

STATUE OF BISMARCK IN THE INTERNATIONAL ART EXHIBITION IN BERLIN.

We publish herewith an engraving (for which we are indebted to the Illustrite Zeitung) of a statue of Bismark, to be seen at the International Art Exhibition, in Berlin. The sculptor, Gustav Eberlein, has chosen quite a different method in representing his subject from that adopted by any of the numerous artists who have heretofore tried to give to posterity a true idea of the Iron Chancellor. He has not attempted to represent him as he appeared at any particular moment of his life, but as he will be thought of years hence, when all minor details will have been forgotten and the character of the hero will have been somewhat idealized. The Prince looks down upon us and we look up to him as we do to the men who are great in the history of the world. Eberlein usually gives poetic feeling to his work, and in this case, some may think, more than the subject warrants. This statue, which is larger than life-size, is not yet complete, for only the plaster cast is

on exhibition, and when a sculptor works on the marble with his own hands, as Eberlein does, the plaster work is not final.

Eberlein has also a number of other works in the exhibition, which give an idea of his versatility, including two graceful groups, "Pygmalion and Galatea" and "Venus Captures Amour," and a masterpiece, entitled "Weeping Over the Body of Christ."

ACTION OF THE X RAYS UPON ELECTRIZED BODIES.

By L. BENOIST and D. HURMUZESCU.

SINCE our first communication on the X rays (February 3), in which we announced that these rays have the property of completely discharging electrized bodies without causing new electrization to appear, and in which we founded upon this property an actinometric method applicable to these radiations, there have been published several memoirs relating to the same phenomena. That of J. J. Thomson formulates conclusions entirely in agreement with our own. The others, such as that of A. Reghi, that of Borgmann and Gerchun, and that of H. Dufour, while agreeing as concerns the discharge of electrized bodies, whatever is the sign of their electrization, signalize an electrization produced directly by these rays without agreeing as to the sign of this electrization, which is positive according to Righi, but negative according to Borgmann and Gerchun.

In view of these discrepancies, we thought it well to repeat our former experiments, greatly prolonging the action of the Crookes tube upon the gold leaves of the electroscope. We constantly observed a complete collapse, whatever was the sign of the original charge, and the absence of any new ultimate divergence.

Fearing a default of sensitiveness for weak charges in the electroscope, we employed a new type of symmetrical mirror electrometer* always completely inclosed in a metal cage communicating with the earth. In the interior of this cage is found, behind a window closed with a leaf of aluminum, the proof plate, which at the outset of each experiment is charged to a potential of about 60 volts. The dielectric which insulates the electrized bodies is absolutely protected from any action on the part of the Crookes tube.

Under these conditions, the discharge was again absolutely complete and definite, whatever was the sign of the initial charge, and whatever the nature of the metal forming the proof plate. For we asked ourselves whether the discrepancies above mentioned might not arise from the nature of the metal. Then if the X rays develop an electric charge, of which we have not observed a trace, this effect does not exceed the order of magnitude of the electrometer forces of contact.

But in the course of these new experiments, we have discovered a new specific property of different bodies, and particularly of metals in reference to the X rays. The metals being taken in disks of the same diameter, and the influence of the variations of the Crookes tube having been ascertained by the method of alternate means, we have observed that the time of fall from a given potential to another varies with the nature of the metal exposed. This is also the character presented by the loss of electricity under the action of the ultra-violet rays.

But the order of the different metals is not the same in both cases. It is known that, according to Leonard and Wolf, who explain these phenomena by a pulverization of the metal, silver is the most sensitive to discharge by the ultra-violet rays; then follow gold, iron, lead, tin, copper, platinum, mercury and zinc. But silver and zinc, which occupy the two extremities of this list, are, on the contrary, very near each other in the list, which we have obtained as regards the action of the X rays, and they occupy the middle, along with gold, iron, nickel, zinc, brass and copper. At the extremities we find, on the one hand, aluminum, in which loss is very slow; and on the other platinum and mercury, in which it is very rapid.

Here follow some figures showing the duration of one and the same fall of potential, taking as unity that of platinum:

Zinc and brass amalgamated	0·96
Platinum in thin plates	1·0
" in beaten leaves	1·1
Ferro-nickel	1·38
Zinc Silver in beaten leaves	1·41
Red copper	1·48
Silver in plates	1·53
Aluminum, hammered	1·92
" in plates	2·12
Lamp black	1·97

These figures are evidently in relation with the tube which we have employed, in view of the heterogeneity of the X rays, which we have already demonstrated.

Hence the aptitude of the different metals to utilize the energy of the X rays for dissipating electricity distinctly varies inversely as their transparency for these rays, since aluminum is decidedly the most transparent of the above metals, while platinum and mercury are the most opaque. This aptitude represents a sort of absorbing power, comparable to that of bodies more or less opaque to the luminous and thermic radiations.

Further, this absorbent power has its seat in the superficial layer of the metal itself, as it increases distinctly with the thickness of this metal when such thickness is still very trifling.

Lamp black, transparent to the X rays, is precisely as little absorbent for aluminum. Thus the time of discharge for a plate of polished copper varies from 1·52 to 1·97 when it is coated with lamp black.

Without, as yet, giving a complete explanation of these phenomena, in view of which we have prepared various experiments, we believe that we may present the following observations:

1. The theory of pulverization does not give this explanation, since it does not appear compatible with the fact observed by us, and also by J. J. Thomson, that the discharge of the electrized metals is effected completely, not only in the air, but also in a solid dielectric medium, like paraffin.

2. The property which dielectrics possess of becoming conductors under the action of the X rays—a property formulated by J. J. Thomson—does not suffice to explain all the circumstances of the phenomena, since the nature of the metal distinctly intervenes up to a certain depth. We have further observed that the relation of the times of discharge found for two different metal surfaces is not modified when the two surfaces are entirely covered with a layer of paraffin of the same thickness. We arranged to repeat this experiment, changing the nature of the dielectric covering.

The results which we have just stated seem to us to indicate in what direction future researches must be conducted in order to obtain preparations more sensitive to the X rays in photography than plates of silver gelatino-bromide. The salts of platinum, being more absorbent, will doubtless be more advantageous, which we purpose to verify.—Comptes Rendus.

* See "Les Rayons X et la Photographie à travers les corps opaques," Ch. Ed. Guillaume, p. 80, Fig. 16.

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